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T H E
PHILOSOPHICAL WORKS

O F
FRANCIS BACON,

Baron of *Verulam*, Viscount *St. Albans*,

and LORD HIGH-CHANCELLOR of *England*;

Methodized, and made *English*, from the ORIGINALS.

W I T H
OCCASIONAL NOTES, to EXPLAIN what is Obscure;
And shew how far the several PLANS of the AUTHOR,
for the Advancement of all the Parts of Knowledge,
have been executed to the present Time.

IN THREE VOLUMES.

By *PETER SHAW*, M. D.

VOL. III.

Multi pertransibunt, & augebitur Scientia.

L O N D O N :

Printed for J. J. and P. KNAPTON, D. MIDWINTER and A. WARD,
A. BETTESWORTH and C. HITCH, J. PEMBERTON, J. OSEBORN
and T. LONGMAN, C. RIVINGTON, F. CLAY, J. BATLEY,
R. HETT, and T. HATCHETT. M.DCC.XXXIII.



INSTAURATION

P A R T III.

A 2

P R E F A C E.

THIS third Part of the *INSTAURATION* seems to have been generally misapprehended; perhaps for want of carefully attending to its Office and Use, as they are distinctly laid down in the *Novum Organum*^a; and further explained in the Author's Aphorisms for compiling a just History of Nature and Art^b.

Indeed, the Work being posthumous, and usually published separate, the Connexion it has with the other Parts of the *Instauration*, could not be fully discovered, without more than ordinary Diligence, and Attention: whence it has been too much considered with regard to itself, or the direct Matter it contains; and not sufficiently, as it sets an Example for prosecuting, and, in some degree, executes, a principal Part of the Author's general Scheme for the Rebuilding of Arts, Sciences, and all human Knowledge, from their surest Foundations: wherein its principal Merit and Excellence consist^c. For the Design and Tendency of this Work, is to lay the Foundations of Inductive History; a Thing, so far as appears, never attempted before^d.

The *Sylva Sylvarum*, therefore, is to be considered as a Collection of the best Materials, which the Author, by his single Abilities, could, in his own Time, procure, in order to this End; that is, to furnish out a proper Set of particular Histories, for the due Interpretation of Nature; the Discovery of Causes; the Investigation of Forms; and the raising of Axioms; that should not only direct a general Practice, or the Perfection of Arts; but also constitute a general Theory for perfecting the Understanding^e. And if it be carefully remembered, that this was the Author's View in collecting the *Sylva Sylvarum*, the Performance will

^a Part I. *Aph.* 117, 118, 119, 120, 121. Page 405 — 409.

^b See Vol. III. pag. 8 — 16.

^c See Vol. I. pag. 13, 14, 15, 44 — 47.

^d See the *de Augmentis Scientiarum* pag. 44. *Novum Organum* Vol. II. pag. 293. and Vol. III. pag. 5.

^e See the *Novum Organum* Part I. *passim*. And Part II. Sect. I. throughout.

will doubtless appear of a much higher, or nobler Nature, and to be better executed, than Men have hitherto generally imagined.

And whoever duly considers the Thing, will not wonder that the End and Design of the *Sylva Sylvarum* should have been misconstrued; when the *Novum Organum*, which was to be wholly employed upon it, has been so little understood: the one being only a part of the Matter, and the other a part of the Instrument, Engine, or Crane, for raising Arts and Sciences, to their greatest Perfection.

It must, indeed, be acknowledged, that the *Sylva Sylvarum* is far from perfect; or from answering the Design of a general History of Nature and Art, in all that Extent and Fullness conceived in the Mind of the Author. And thus much is freely confessed by himself; when he ingenuously declares, that "the Natural History he has been able to procure, is not so copious, and so well verified, as alone to serve for, or even administer to, a genuine Interpretation of Nature." And again, that "it is a royal Work, requiring the Purse of a Prince, and the Assistance of a People; the Materials of the Understanding being so diffusive, that they must, like Merchandize, be imported from all Quarters," &c.^s It were, therefore, extremely supine, and inconsiderate, to expect that from the Labours of a single Person (otherwise sufficiently employed) which is, in reality, the Work of many; and, if proper Care be not taken, may prove the Work of Ages. We are likewise to consider, according to the Intimation given above, that the Work did not receive the last Hand of the Author; and, being published after his Death, is, on that Account, not so correct as it would have been, had he lived to revise, and sit upon it, from Year to Year, in his usual manner. But imperfect as he left it, perhaps it may still be found a Work singular in its kind; and hitherto unequalled; or rather, not carefully continued. For it might be proper, with prudent Moderation, and suitable Deference, to enquire, what has been done towards perfecting this general History of Nature and Art, since the Time of the Author; upon the Plan which he left us, and the Light he afforded for the Purpose. And, with due Reverence and Respect to the past and present Age, it should seem as if the Author's Intention had been somewhat mistaken; or at least, as if his Example had not been exactly followed.

'Tis certain, that noble Collections of philosophical Materials have been made in England, France, Germany, &c. as appears in the Philosophical Transactions of the Royal Society of London; the Memoirs of the Royal Academy of Sciences at Paris; the *Acta Eruditorum*, and Ephemerides of the German Academicians, &c. But surely the
Matters

^f See *Novum Organum* Part I. Aph. 117. See also Vol. I. pag. 13—15, 44—47.

^s Vol. III. pag. 6, 7. *Novum Organum* Part I. Aph. 98, 111, &c.

Matters thus collected, and treasured up, tho highly excellent and useful, seem rather accidental, or casual; as Things themselves happen to turn up; or as Mens Studies and Inclinations prompt and lead; than purposely sought out, with a View to Inductive History, and Axiomatical Philosophy. And hence it happens, that when any particular Natural Enquiry is gone upon, in the Inductive Method, we even at this Day are at a loss for the Prerogative Instances, capable of leading, in a short way, to a just Determination. So that the Persons who should act the Part of Interpreters of Nature, are obliged to turn Historians; and instead of exercising the Understanding in forming a proper Induction, are obliged to go in quest of Materials; and themselves procure the requisite Facts, and make the needful Observations and Experiments. No wonder, therefore, if the Structure of serviceable and effective Philosophy rises slowly, when the Materials for it are not yet collected, and brought together, into any one, two, or more, general Repositories.

Barely to intimate this may suffice for the present, in order to bring us better acquainted with what the Author means by Induction; the Investigation of Forms; and the Interpretation of Nature; that is, with the little regarded, but immensely useful Doctrine of his Novum Organum, or Philosophical Algebra; which, as we above observed, was to be solely employed upon proper Materials, collected in the manner of the following Memoirs for a History of Nature and Art; so as, in due time, to procure a general System of Inductive History; in exact Conformity with Nature herself.

Such was the View and Design of the following Memoirs: and to render them the more subservient to this End, the fitter for Use, and the more capable of Improvement, we have altered their Order; and, according to the Author's Direction, placed them in the Storehouse, or Repository, so as to be readily found, when they come to be wanted: that is, we have placed them in Alphabetical Order; which seems, in a particular manner, to suit the Rudiments of natural Knowledge, and the Embryo of scattered History.

The Notes occasionally added, we hope, will more fully open the Design and Scope of the Piece; so as to render it generally intelligible; and lead to its farther Advancement.



THE
C O N T E N T S
O F T H E
Third V O L U M E.

SYLVA SYLVARUM:
O R, T H E
Phænomena of the Universe, &c.

I N T R O D U C T I O N.

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PAGE 4. Line 11. dele *who*. P. 34. l. 37. for *covered* r. *discovered*. P. 55. l. 39. for *rea-* r. *reason*. P. 85. l. 40. for *Pitcarin's* r. *Pitcairn's*. P. 95. l. 27. for *Fire* r. *Time*; and so in the marginal Note. P. 102. l. 45. for *Intension* r. *Intention*. P. 286. l. 20. for *transposing* r. *transporting*, in the marginal Note. P. 296. l. ult. for *largest* (the Catch Word) r. *Root*. P. 313. l. 42. for *all Things else*, r. *all other Things*. P. 314 l. 22. dele *and*. P. 322. l. 23. for *Enquiries* r. *Enquiry*. P. 327. l. penult. dele the Comma at *drawn*, and place it at *up*. P. 360. l. 19. place a Semicolon after *Years*. P. 361. l. 13. dele *wish his Tongue*. P. 362. l. 12. after *Life* insert *which*. Ibid. l. 16. in the marginal Note, for *Emperor* r. *Emperors*. P. 364. l. 25. place a Comma after *Donatus*.

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T H E

Phænomena of the Universe ;

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INTRODUCTION.

SECT. I.

Of the just Method of compiling a NATURAL and EXPERIMENTAL HISTORY; for the Service of PHILOSOPHY, or the farther Discovery and Advancement of Arts and Sciences.

1. **A**S Mankind appear to us unacquainted with the ways both *The Design of* of judging and *experimenting*, we would attempt to remedy *the ensuing Hi-* this Misfortune; and cannot perhaps deserve better of *story.* them, than by endeavouring to free them from the tyranny of *false Doctrines and Theories*; raise them from the Languor they lie under with regard to *Experiments*; and bring them, by a kind of *learned Experience*^a, to a more close and exact Acquaintance with things themselves: so that the Understanding, being placed upon a secure Eminence, may discover the ready way of procuring of all the more useful and necessary things.

2. The foundation of this Design must be laid in a *History of Nature*; for *The Founda-* all the Philosophy at present received, appears to us built upon too narrow *tion of the De-* a Basis of *Natural History*; and to have pronounced upon too few Premises. *sign.* For having seized on certain Traditions of Experience; and this sometimes without a careful Examination; Men have trusted every thing else to

B 2

Con-

^a See the *De Augmentis Scientiarum*, Sect. XII. of LEARNED EXPERIENCE.

Contemplation, Genius and Dispute ; with the assistance only of the *common Logick* for their better Security.

An Exhortation to Men for Recovering their Dominion over the Works of Nature ; drawn from the Differences of Opinions.

3. But they are to be admonished, and earnestly intreated, as they value their own Happiness, to humble their Minds ; and look for the *Sciences* in the great World about them : for unless a careful and approved *natural* and *experimental History* be procured, we must quit all thoughts of *Philosophy* ; or can at best expect but very slender Advantage from it. There were swarms of Opinions among the ancient Philosophers ; *Pythagoras, Philolaus, Xenophanes, Heraclitus, Empedocles, Parmenides, Anaxagoras, Leucippus, Democritus, Plato, Aristotle, Theophrastus, Zeno, &c.* who all of them raised *Hypotheses* at pleasure, as so many *Fables of Worlds* ; and propagated and published them, some with more and some with less Elegance and Probability ^b. But in our Age the Genius's of Men are more confined, by the founding of Schools and Colleges ; yet *Patricius, Telesius, Brunus, Scriverius, Gilbert* and *Campanella*, have trod the Stage, and acted new Parts ; tho with little Applause, and little Choice of Subject ^c. And in this way there might infinite *Opinions* and *Seets* arise in all Ages : nor is there yet, or ever will be, an End or Measure observed in this matter. One lays hold of this, another of that ; different Men delight in different things : there is no *dry and pure Light amongst Mankind* ; but every one philosophizes out of the narrow Cells of his own Imagination ; the sublime Genius's, with more Sagacity and Felicity ; and the ordinary sort, with less Success, tho no less Obstinacy ^d.

The Confinement of the Sciences.

4. But of late, by the Doctrine of certain learned Men, join'd perhaps with some dislike of the former licentiousness, and difference, in Opinions, the *Sciences* are confined to a *few particular Authors* ^e ; and in this Confinement impose upon the Old, and prejudice the Young : insomuch that every thing is transacted as 'twere by an *Edit* ; and *Authority* goes for *Truth*, not *Truth* for *Authority*. This kind of Discipline, however useful it may be for the present, yet certainly excludes, and banishes, much better things. Indeed we all experience and imitate the Sin of our first Parents ; they *would be as Gods* : but we go farther, for *we will be creating new Worlds*, ever going before and lording it over Nature ; and would have all things be *as seems best to our own Folly*, not to the *divine Wisdom*, or as they are in Nature ^f.

And

^b The Author's Design has a Tendency to make all Men of one Opinion ; by bringing them all to the Standard of Nature, which is ever one and the same : for different Opinions in *Philosophy* only proceed from our Ignorance of Nature, or a want of knowing how things really are in themselves.

^c *Des Cartes*, since these, had greater Success, and made all *Europe* fond of a *Philosophy* that now begins to be despised, and treated as a Dream : and this, 'tis probable, will ever be the Case with *false Philosophies* ; which are no better than *Visions*, that please for a time, but either vanish at the approach of Truth, or else give way to new Successions of Fiction and Illusion.

^d It should seem that very few useful Discoveries have been made in *Philosophy*, but by the *Method of Induction* : at least, it is evident that *Mr. Boyle* and *Sir Isaac Newton* proceeded in that *Method* ; as more fully appears in the *Notes upon the Novum Organum*.

^e Suppose *Aristotle* and his *Commentators* in *Philosophy*, and those we call the *Classicks* in the *Humanities*.

^f It were much to be wished this just Censure might have its just Weight ; and incline us to search prudently into the *Wisdom of the Creation*, without fondly imagining it is to be found at the

And 'tis a Question, whether we distort Things or our own Minds the most ; but we certainly stamp the *Seal of our own Image* upon the Creatures and Works of God, instead of carefully inspecting and acknowledging the *Seals of the Creator* : whence 'tis but just, that we are again fallen from our *Empire over the Creation*. And thus, tho, after the first Fall, Man had still some Dominion left him over the rebellious Creatures ; so as by true and solid *Arts* to subdue and bend them to his Purpose ; yet, by our Pride, and Desire of being *like God*, and following the Dictates of our own *Reason* ^b, we have in great measure lost it. Therefore, if we have any Humility towards the Creator ; if we have any Reverence and Esteem of his Works ; if we have any Charity towards Men, or any Desire of relieving their Miseries and Necessities ; if we have any Love for natural Truths ; any Aversion to Darkness ; and any Desire of purifying the Understanding ; Mankind are to be most affectionately intreated, and beseeched, to lay aside, at least for a while, their *presumptuous, fantastick and hypothetical Philosophies*, (which have led *Experience captive*, and childishly triumphed over the Works of God ^a;) and now at length, condescend, with due Submission and Veneration, to approach and peruse the *Volume of the Creation* ; dwell some time upon it ; and, bringing to the Work a Mind well purged of Opinions, Idols and false Notions, converse familiarly therein. This Volume is the *Language* which has gone out to *all the Ends of the Earth*, unaffected by the confusion of *Babel* ; this is the Language that Men should thoroughly learn, and not disdain to have its Alphabet perpetually in their Hands : and in the Interpretation of this *Language* they should spare no Pains ; but strenuously proceed, persevere and dwell upon it to the last ⁱ.

5. To promote this capital End we are willing to leave, for the present, many principal Parts of our *Novum Organum*, or *new Logick*, unfinished ; as chusing to set on foot, and promote, *all the Parts of our INSTAURATION*, rather than to perfect a few of them ; with this ardent and constant Desire, that what was never attempted before, may not now be attempted in vain ^k. We have also considered, that tho doubtless there are spread

The Author's Reasons for leaving the Novum Organum unfinished, to pursue the History of Nature.

the Entrance of Things. For all that has hitherto been done in *Philosophy*, notwithstanding the modern Discoveries, is no more than the *Dawn before Day-light*.

^a It is evident, that the Author here understands by *Reason*, that strange Faculty we indulge of *reasoning* about things, so as to square and mould them to our own Fancy ; instead of reasoning justly from close Observation and careful Experience, according to the Method delivered in the *Novum Organum*.

^b The meaning is, that when *Phænomena are solved*, as 'tis called, by *Hypothesis* and *Reasoning*, without consulting *Nature* and *Experience*, Men usually applaud themselves, as if they had made some wonderful Discovery, or had conquered Nature in certain Points ; when at the same time she is *slipt thro' their Fingers* ; and the whole Process has been no more than the sport of Fancy : but the Remedy here is *Induction*. See *Novum Organum*, Part II. Sect. I. and II.

ⁱ Tho this may seem a kind of Repetition of what has already been touched upon in the *De Augmentis* and *Novum Organum*, it is not unseasonable here, at the Entrance of a *History of Nature* ; to shew what ought to be the primary View and Design thereof : especially as the Mind is so extremely prone to quit the Drudgery of Enquiry, and slip into the facile Paths of *Fiction* and *Fancy*.

^k It may seem strange that no Philosophers of former Ages, should have gone upon the direct Enquiry into Nature, but all have turned aside to *Theories, Hypotheses* and *Opinions* ; and yet,

spread over *Europe* great numbers of extensive, free, sublime, penetrating, solid and settled Genius's, some whereof may perceive, and perhaps approve, the *Scope* and *Use* of our *new Logick*, and yet not know how to proceed, and apply themselves to real *Philosophy*¹. If the Business depended upon the reading of philosophical Books, Dispute, or force of Thought, they might be abundantly qualified for it; but as we refer them to the *History of Nature*, and the *Experiments of Arts*, they may stick here, as at a thing unsuitable, or requiring too much *Time* and *Expence*; whilst we cannot desire any one should quit his former *Knowledge*, before we put him in possession of better. But after a faithful and copious *History of Nature and Arts* shall be collected, digested, laid before, and opened to Mankind; there are hopes that such great Genius's as those above-mentioned, who both in ancient and later Times have been so ready and expert, as by wonderful Artifice and Workmanship to build *Systems of Philosophy from the poorest Materials*; will not fail to raise more solid Structures, when possessed of good and sound Materials for the Purpose: and this tho they should chuse to proceed in the old Way, rather than in that laid down by our *new Logick*; which appears to us either the only one, or the best for the Purpose^m. So that upon the whole, tho our *new Logick* were perfected, yet could it not greatly promote the Re-establishment of the *Sciences*; without the *Natural History* we speak of: whilst this *Natural History* may greatly promote the same End, without the Assistance of our *new Logick*. And therefore we judge it most adviseable, first, and above all things, to endeavour at procuring this *History*.

This History of large extent.

6. But the *History* we conceive in our Mind, is a thing of large Extent, and not to be procured without great Labour and Expence; as requiring the assistance of numerous Hands; and being rather the work of a *Prince* and a *People*, than of a *private Person*. And tho we might perhaps of ourselves be able to perform what appertains to the *Conduct of the Understanding*ⁿ; yet the *Materials of the Understanding* are so diffusive, that they require to be every where collected and imported to us, as it were by Factors and

yet, for any thing extant to the contrary, this appears to have been the case, among the *Greeks* especially; except a few faint Attempts. Tho perhaps, the ancient *Egyptians*, the *Chaldeans* and the *Chinese*, followed Nature closer than the *Greeks*. But the *Chinese Philosophy* was very imperfectly known at the time of our Author: the most of what we know of it to this day, in *Europe*, being handed to us by the late *Jesuit Missionaries*.

¹ The Author was well aware of the Difficulty there would be to bring Men into the right Use of his *new Logick*; he suspected that only the more Intelligent would thoroughly understand it: and the more Intelligent generally abound in *Schemes* and *Methods* of their own, which they are apt to prefer to those of others. But since the most successful Philosophers among the Moderns, as particularly Mr. Boyle, Dr. Hook, Mr. Locke, and Sir Isaac Newton, have, in some degree, followed the Method of *Induction*, and by that Means made considerable Discoveries; it is to be hoped. Posterity will rather follow such eminent Examples, than trust to any other Methods; which, tho more pompous and shewy, and, in appearance, expeditious, have, upon Trial and Experience, been rejected as deceitful and erroneous.

^m If such a *History of Nature*, as the Author here describes, were procured, Men of common Capacities might then make new Discoveries with tolerable Ease and Facility; somewhat like those of Sir Isaac Newton, when the necessary *Facts*, *Observations* and *Experiments* lay before him.

ⁿ That is to the finishing of the *Novum Organum*. See that Piece, Part II. Sect. II. *ad finem*.

and Merchants^o. To this we add, that 'tis trespassing too much upon ourselves, to bestow our own particular Time and Labour in a matter that lies open to the industry of all Men: but for the principal part of the Business, we will now set about it; and, with diligence and exactness, propose the manner and Platform of such a *History*, as may answer our Design: lest Mankind, remaining unadvertised, shou'd deviate from the Purpose, conform themselves to the Examples of the *Natural Histories already extant*, and wander wide of our Intention. And what we have often said, must here again be strongly repeated; viz. that *tho the Genius's of all Ages should have united, or shall hereafter unite, together; tho the entire Race of Mankind shou'd have addrest, or shall addrest, themselves to Philosophy; tho the whole habitable World were nothing but Universities, Societies, Colleges, and Schools of learned Men; yet without such a natural and experimental History as we have now in view, there neither cou'd have been, nor can be, any progress made in Philosophy, and the Sciences, worthy of Mankind*. On the other hand, when such a *History* is procured, and duly furnished, with the addition of such auxiliary and leading *Experiments*, as either occur, or shall be struck out in the course of *Interpretation*; the Enquiry into *Nature*, and *all the Sciences*, will be but the work of a few Years: And therefore this *History* must either be procured, or the Business be deserted. For by this means alone can the Foundations of a true and active *Philosophy* be laid; and Mankind be made to see, as if waked from a Dream, what a difference there is between the Opinions and Fictions of the Brain, and real *effective Philosophy*; and again, what, at length, it is to *consult Nature about the things of Nature^p*. We will therefore in the first place, lay down certain *general Precepts or Rules for compiling a History* of this kind; and afterwards set a *particular Example or Pattern* thereof before the Eyes of Mankind; pointing out, as we proceed, those things whereto the *Enquiry* should be adapted, and referred, as well as those to be sought after; that the whole scope of the matter being well understood and foreseen, other particulars may be brought to the Minds of others, that had escap'd ourselves: and to this *HISTORY*, we give the name of *PRIMARY or MOTHER-HISTORY^q*.

A

^o These Materials are now imported to *England*, and other Countries, in considerable Plenty; and a kind of Traffick, in Learning and Knowledge, settled by means of the *Philosophical Transactions*, the *French Memoirs*, the *Acta Eruditorum*, the *German Ephemerides*, and great numbers of *foreign Journals*, of late published, and still continued, in *Holland, France, Germany, Italy*. &c. so that if Men were sufficiently disposed to improve this *History*, it might soon be finished, to that degree of Perfection the Author seems to have intended.

^p The truth and justness of this Paragraph will appear to those who consider the Thing; or have read what is before delivered upon the subject of a *NATURAL HISTORY*, in the *de Augmentis & Novum Organum*. And certainly there can be no such thing as a *serviceable and universal Philosophy*, without a copious and extensive *History of Nature and Arts*, which are the very matter of such a *Philosophy*; that when duly ranged, explained, deduced. or, as the Author terms it, *interpreted*, and then form'd into *Axioms*, or *short Directions* for future Use, will seem brought to the utmost Perfection requisite or possible for Mankind.

^q If the Reader will bear in Mind this Scope and Design of the Author, he may form the truer Judgment of the *Sylva Sylvarum*; which appears, for want of a proper Attention, to have been much undervalued. See the Note upon *Aphorism II.* below.

A Set of APHORISMS for compiling a just HISTORY OF NATURE AND ART.

A P H O R I S M I.

That this History be not wrote in too strict a Method.

7. **N**ATURE appears in three States, or under three kinds of Regulation: For (1.) She is either free, and proceeds in her ordinary Course; or (2.) is forced out of it by the depravity and intractability of Matter, and the violence of Impediments; or else (3.) She is bound and wrought by Art and human Administration. The *first* State regards the production of all *Species*; the *second* the production of *Monsters*; and the *third* the production of *artificial Things*. For in *things Artificial*, Nature takes the ply from the over-ruling of Mankind; as they wou'd never have been produced without human Assistance: but by the labour and interposition of Man, there appears a perfectly new Face of Bodies; and as 'twere another Universe or Scene of Things^r. *Natural History*, therefore, is of three Kinds, and treats (1.) of the *Freedom*, (2.) the *Errors*, and, (3.) the *Bonds of Nature*; whence it may justly be divided into the *History of Generations*, *Pretergenerations* and *Arts*; the latter whereof we also call *mechanical and experimental History*^t. But we do not direct that these three shou'd be treated apart; for the *Histories of Monsters*, in each *Species*, may very well be join'd with the *History of the Species*, or Bodies, themselves. Sometimes also, *things Artificial* may be properly join'd along with *Species*; and sometimes 'tis better to separate them: whence 'tis very advisable to consider of their Conjunction or Separation occasionally; for too *strict a Method*, and no Method at all, equally occasion *Repetitions* and *Prolixity*^r.

A P H O R I S M II.

The End of this History to be for Induction.

8. **N**atural History has two Uses; the one with respect to the things themselves that are committed to History; the other with respect to *the first matter of Philosophy*; or the Provision and Apparatus of a *true Induction*: the latter is the thing we now intend; and was never intended before. For neither *Aristotle*, *Theophrastus*, *Dioscorides*, nor *Pliny*, much less the *Moderns*, ever propos'd to themselves this End of *Natural History*. And yet it is of the utmost Importance, that whoever shall hereafter undertake to write any Portion of *Natural History*, shou'd determine not to study *the pleasure of the Reader*, nor even *immediate Usefulness* itself; but every where to *hunt up, and collect together a quantity and variety of matters, to serve for the forming of true Axioms*: and if they take but this into Consideration, it will of itself direct

^r See Mr. Boyle's Essays upon the Usefulness of *Natural Philosophy*.

^t See *de Augment. Scientiar.* Sect. I. of *History*.

^r The Reader will find this *Aphorism*, and all the rest, exemplified by the Author, in his own *Specimen of a History of Nature*, or the *Sylva Sylvarum* now pressently to follow.

direct the Means of procuring the *History* we propose ; for 'tis the *End* that governs the *Means* ^u.

APHORISM III.

9. **A**ND as this is a Work of much Pains and Labour, the less shou'd ^{its Bulk to be} it be burden'd with things superfluous. Men are therefore to be ^{contrasted.} well advertised of *three Particulars* ; that they may not misemploy their ^{(1.) By omitting all foreign} Time, in what might swell the bulk of the Work, without adding to its ^{Ornaments.} Merit. (1.) The first Particular is, that all Antiquities, Quotations, and Authorities of Authors, be laid aside ; all Contests, Controversies, and contrary Opinions ; together with all philological Ornaments : and let no Author be cited, but in doubtful Cases ; nor Controversy mention'd, but in Subjects of great Consequence : and as for embellishment of Style, metaphorical Expressions, and studied Eloquence, with the like lighter Matters, they should be wholly rejected. And let whatever is received, be delivered closely and concisely ; that words may have the least share in it ^w. For no one who collects, and lays up, materials for a Building, places them beautifully for Shew, as in a Shop ; but is only solicitous that they be sound and good, and possess not too much room in the Store-house : and this *Example* should be carefully followed, in compiling our intended History

10. (2.) The common luxuriancy of *Natural Histories*, running out into numerous Descriptions, Characters and Figures of *Species*, and their curious variations ^{(2.) Descriptions}, makes little to the purpose ; such small variations being but the sport ^{Curiosities} and wantonness of Nature, and near approaches to the Individuals : so that tho there may be a beautiful and agreeable deviation in the things themselves, yet this affords but a slender, and almost needless, Information, to the improvement of the *Sciences*.

11. (3.) All *superstitious Relations*, and the Experiments of ceremonial Magic, are entirely to be dropt ; tho without absolutely excluding *Things prodigious* ; where the account of them is probable, and worthy of Credit : for the Infancy of Philosophy, which is nursed by Natural History, should not

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^u Many Persons, not attending to this *End* of the *Sylva Sylvarum*, have treated it as a kind of *Rhapsody*, or trifling Collection of Rumors and Relations ; without at all discerning the Drift and Tendency thereof ; or entering into the Design and View of the Author. Such a misconstruction of so capital a Work, undertaken with such great Labour, Thought, and Judgment, must needs be very discouraging to those who wou'd follow its Steps ; especially, when this kind of misconstruction is found in Men eminent for Learning. And yet, unless this plain and homely Method be pursued, in procuring a *History of Nature* ; Mankind must still be left to struggle with Difficulties, and grovel in Darkness. It shou'd therefore be observed, for the Encouragement and Benefit of others, that learned Men, or those who commonly pass for such, may be very little qualified to judge of *Philosophical Performances* ; or for discovering the excellency of those things, which, tho extensively useful, are not dress'd out with Philological Ornaments, or other Embellishments, really foreign, and prejudicial, to the *Investigation of Truth*.

^w The Business is not now to gain upon Men's Affections, or win them over to *Philosophy*, by Eloquence, Similitudes, or the Art of Writing ; which the Author practis'd in the *de Augmentis* ; but carefully to enquire into, and justly to copy, and describe, Nature, as she is in herself ; and here the Style cannot well be too plain and simple.

be fed with *Fables*. There may, perhaps, come a time (when a farther Progress shall be made in the Enquiry into Nature) for touching these things lightly; to try if any *natural Powers* cleave to such Dregs, and can be separated from them for Use; but in the mean time they must be set aside. The *Experiments*, likewise, of *Natural Magick* are to be carefully sifted, before they are received; particularly those which Sloth, and Credulity, have admitted, and improved, from the vulgar *Sympathies* and *Antipathies*.

The Example of a Builder to be followed in the Compilement.

12. And no small Point will be gain'd, by thus disburdening *Natural History* of these *three superfluous Things*, which might otherwise fill whole Volumes. Nor is this all; for *large Works* require that the things received into them, should as well be concisely wrote, as superfluities omitted; tho, doubtless, this strictness and brevity will afford less Pleasure, both to the Writer and the Reader: but it must always be remembred, that the Point of View here, is to procure and furnish a *Store-room* or *Repository*; not a House to dwell in for Pleasure; but to enter into upon occasion, as any thing is required for Use, in the *business of Interpretation* that is to succeed^x.

A P H O R I S M IV.

This History to be made Universal; and so contain,

13. **I**T is also a capital thing in this our intended *History*, that it be *extensive*, and made to the *measure of the Universe*; for the World is not to be squeez'd up to the narrowness of our Understanding, as it hitherto has been; but the Understanding is to be dilated, to receive the Image of the World, as we find it: for to regard only a few *Phænomena*, and to pronounce according to them, is the bane of Philosophy^y.

(1.) The History of Generations, consisting of five Parts.

14. To proceed, therefore, with our division of *Natural History* into *Generations*, *Prætergenerations*, and *Arts*; we make the *History of Generations* to consist of *five Parts*; viz. (1.) The *History of the Æther, and celestial Bodies*; (2.) The *History of Meteors, and the Regions of the Air*; or all that space betwixt the Moon and the Surface of the Earth; including also, for the sake of Order, the *Comets, both higher and lower*; (3.) The *History of the Earth and Sea*; (4.) The *History of the Elements*, as they are call'd, or *Fire, Air, Earth, and Water*; taking the Elements not for primordial Matters, but *larger Masses* of natural Bodies. For the nature of things is so laid out, as to form a very large quantity, or *mass*, of certain Bodies in the Universe; where an easy and loose texture of Matter is required to their Structure, as in these *four Elements*; whilst there is but a proportionably small quantity of certain other Bodies in the Universe; thus sparingly supplied, by reason of a very dissimilar and subtiler Texture of the Matter, here made Organical;

^x The Author's *inductive Histories* of *Life and Death, Winds, Rarity and Density*, are Instances of the use to be made of this general *History of Nature and Experiments*. But this matter has been already sufficiently clear'd up in the *Novum Organum*. See *Part II.* of that Work.

^y And, in reality, a weakness, or species of Folly. See the *first Part* of the *Novum Organum*.

ganical ; and determined in many Particulars ²; as in the *Species* of natural Bodies ; Minerals, Plants, and Animals : whence we call the former kind, *larger Assemblages* ; and the latter, *lesser Assemblages* of Matter. And these *larger Assemblages* make the *fourth part* of our History. Nor do we here confound the *fourth Part* with the *second* or *third* ; by having mentioned *Air, Water* and *Earth* in each of them ; because in the *second* and *third*, their *History* is meant of the integral Parts of the World ; and as they relate to the Structure and Configuration of the *Universe* : whilst the *fourth* contains the *History* of their Substance, and Nature, which prevails in each similar part thereof, without regard to the whole. (5.) And Lastly, the *fifth part* of our *History* contains the *lesser Assemblages*, or *particular Species* of Bodies ; about which alone all *Natural History* has hitherto been principally employ'd.

15. The *History of Pretergenerations*, we before observed, may be very (2.) *The History* commodiously joined with the *History of Generations* ; so far as 'tis only *pre-* of *Pretergenerations*. *digious*, yet natural ^a ; referring the *superstitious History of Miracles*, of all kinds, to a *peculiar Treatise* by themselves : tho this is not to be undertaken immediately, at the entrance ; but after some farther Progress is made in the *Enquiry of Nature*.

16. The *History of Arts*, and Nature fashioned and changed by human And (3.) *the* means, we divide into three Parts ; as 'tis drawn either, (1.) from the mecha- *History of Arts*, nical Arts ; (2.) from the effective part of the liberal Sciences ; or, (3.) from the numerous Practices and Experiments which are not yet formed into proper Arts ; or which sometimes turn up in vulgar Experience, and require no Art at all. So that if a *History* were compiled of *Generations, Pretergenerations, Arts*, and *Experiments*, there seems to be nothing omitted for enabling the Senses to inform the Understanding ^b : and thus we should no longer frisk about, as it were, in little enchanted Circles ; but encompass the whole extent and circumference of the World.

APHORISM V.

17. **A**Mong the several Parts of this *History*, that of *Arts* is the most *A more parti-* useful ; as it shews things in Motion, and leads more directly to *cular regard to* Practice. It likewise unveils, and takes off the Mask from, natural Things ; *be had to the* which are generally concealed, and darkened, under a variety of Forms, and *History of* external Appearances. Again, the *Tortures of Art* are like the Bonds and *Arts*. Shackles of *Proteus*, which discover the ultimate Attempts and Endeavours of Matter : for Bodies will not be destroyed, or annihilated, but rather change themselves into various Shapes ; and therefore the greater Care

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² The Author here intimates the *physical Reason*, why there are more of some Bodies in the Universe than of others ; a thing set down as deficient in the *de Augmentis Scientiarum* ; under the Doctrine of *Transcendentals*. See that Work, *Self. III. 4.*

^a See above, *Aphorism II.*

^b With this view the Author seems to have drawn up the *Catalogue of particular Histories*, in the following *Section*.

and Diligence is to be used in preparing this *History*; tho' it may seem to some but a *mechanical* and *illiberal* thing.

And among them, chiefly to those that change and prepare natural Bodies.

18. Among *Arts*, those are to be preter'd which *treat*, *alter*, and *prepare*, *natural Bodies* and *Materials*; as *Agriculture*, *Cookery*, *Chemistry*, *Dying*, the *Art of Glass*, *Enamelling*, *Sugar-baking*, *Powder-making*, *artificial Fire-works*, the *Art of Paper*, &c. But those are of less substantial Use, which principally consist in the subtle Motion of the Hand and Instruments; as *Weaving*, *Carpentry*, *Building*, the *Art of Mills*, *Clock-making*, &c. tho' these also should by no means be neglected; because many things occur in them, which regard the Alterations of natural Bodies: and again, because they give an exact Information of the *Motion of Transposition*; which is a thing of great moment in many respects.

The collecting of eminent Instances in Arts, to be more regarded than the perfecting of Arts themselves.

19. This Admonition must be well remembered thro' the Whole; that not only such *Experiments of Arts* should be received as lead to the End of the Art; but those also which any way turn up in it. Thus, for Example, tho' it makes nothing for the Table, that the dusky Colour of Crabs and Lobsters changes to red in boiling; yet this is no improper Instance in the Enquiry into the Nature of Redness; as the same thing likewise happens in the burning of Bricks. So again, that Meat sooner takes Salt in Winter than in Summer, serves not only to direct the Cook in his seasoning of it; but is also a good Instance for indicating the Nature and Impression of Cold. And therefore he will absolutely mistake our Purpose, who thinks to answer it by collecting the Experiments of Arts, to this End only, that each Art may by such means be perfected the better: for altho' we do not entirely despise such a Procedure, in many Cases; yet our direct Intention is to turn the Rivers of mechanical Experiments, from every Quarter, into the Ocean of Philosophy^a. And the choice of eminent Instances in each kind, which ought principally, and with the utmost Diligence, to be searched out, and hunted up, must be derived from the Doctrine or Knowledge of *prerogative Instances*.

A P H O R I S M VI.

That common and mean Matters be received into this History.

20. WE must next briefly repeat, in the way of *Precept*, what is more largely discussed in our *new Logick*^c, viz. That, *first*, the commonest things be received into this History; and such as being familiarly known

^a All the Objections that might be made to such a History, seem sufficiently obviated in the *Novum Organum*, Part I. Sect. VII. 3, 4, 5, 6, 7, 8, &c.

^b The utmost address seems requisite to convince Mankind of the nobleness and great utility of this Design. There is a strange Reluctance, and a kind of Loathing in the Mind, with regard to *mechanical Experience*, and the homely Observations of the Kitchen, the Dairy, the Cellar, servile Arts, and the like: and yet the most necessary, and serviceable part of all *Natural Philosophy*, must be derived from such Observations. And they who despise Nature in these lower Works, must expect that Nature will despise them; or not admit them into her secret Operations. To give a single Instance; is not a just Knowledge of *Fermentation*, in its Theory and Practice, a greater Enrichment to *Natural Philosophy*, and of more immediate Service in Life, than the Doctrine of Curves; or the making of Gold?

^c See this fully explained in the second Part of the *Novum Organum*, Sect. II. where the important Doctrine of Instances is largely prosecuted.

^d See Part I. Sect. VII. 3, 4, 5, 6, &c.

known might seem unnecessarily committed to Writing: *secondly*, even ignoble, illiberal and trivial Matters; for Light and Information must be sought from every Quarter; and Men in this case are again to become Children: and, *thirdly*, that such things must also be here received, as seem of too great Subtlety to be in themselves of any Use: for the Matters to be collected in such a History, are not, as we before observed, collected for their own sakes; and therefore their Dignity is not to be measured by itself: but according to their suitableness for entering the Body of Philosophy [†].

APHORISM VII.

21. **L**ET it be another Rule, that *every thing, as well in the Bodies themselves, as their Powers, be, as much as possible, delivered in Number, Weight, Measure and Proportion*; for we intend not Speculations, but Works: and it is a suitable Mixture of *Physicks* and *Mathematicks*, that produces Practice. And therefore the exact *Revolutions*, and *Distances*, of the Planets, are to come in the *History of the heavenly Bodies*; the Circumference of the Earth, and the Proportion of its Surface, with regard to that of the Water, in the *History of the Earth and Sea*; what degree of Compression the Air will sustain, without a strong Reluctance, in the *History of the Air*; the relative specifick Gravities of one Metal in respect of another, in the *History of Metals*; with numerous Particulars of like kind; which are to be carefully searched out and noted [‡]. But when exact Proportions cannot be had, we must take up with Estimation, or indeterminate Comparison: as for example, if we distrust the astronomical Calculation of Distances, we must be content to say, that Mercury is above the Moon, &c. So again, when mean Proportions cannot be had, let the Extremes be given: as, for example, that a weak Loadstone raises such a weight of Iron, in respect of the Stone, and the strongest sixty times its own weight; as I have seen in a very small armed Magnet. But we are aware, that these *determinate Instances* do not easily, or frequently occur; tho' they ought to be endeavoured after, as *Auxiliaries*, when the Matter greatly requires them, thro' the course of *Interpretation*. However, if they happen to occur, they ought to be inserted; provided they do not too much retard the Progress of the *History* [§].

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[†] Let no one, therefore, be rash in censuring the Author's *Sylva Sylvarum*; which, when well understood, seems pregnant with the *proper Matter* for a *General History of Nature and Experience*; that serves as the Basis of inductive History, and solid *universal Philosophy*. Certainly, none but those of large and comprehensive Views, or Men well versed in *Nature and Experience*, should judge of such a Performance. See the Note upon *Aphorism II.* above.

[‡] The Excellence of the modern *Mathematical Philosophy*, is perhaps in nothing more conspicuous, than a careful observance of this useful Rule. Nor were it possible to predict *Eclipses* so that *Precisely* we do at present, without a tolerably exact knowledge of the Orbits, the relative Magnitudes and Distances of the celestial Bodies: which have been discovered by repeated Observation, and brought into Tables.

[§] The determining of these absolute and relative Proportions of Powers, Magnitudes and Distances, seems the principal Use of *Mathematicks* in Philosophy; and that whereto it should be chiefly confined; for Magnitude, or Quantity, is the proper Object of *Mathematicks*: but
when

A P H O R I S M VIII.

In what manner the several kinds of Matters are to be admitted into this History.

22. **A**S to the Authority of the Matters to be received into this History, it must of necessity be either good, doubtful, or bad: the first kind is to be proposed naked; the second with a Mark affixed; or with an *It is said*: *I was told by a Person of Credit*, &c. for it would be too tedious, and delay the Writer too much, to set down the Arguments for and against the credibility of what he delivers: nor would this greatly avail to the Business in hand; because, as we formerly observed^k, the Truth of *Axioms* will soon after prove the Falsity of Experiments, unless such false Experiments should super-abound. But if the Instance should be a noble one, either for Use, or because much may depend upon it; then the Author must by all means be mentioned: and that not barely, but with some notice, whether he took it from Report, or transcribed it, as *Pliny* generally did; or whether he affirms it of his own knowledge; whether it were of his own, or a more ancient, time; whether of that nature as to require many Witnesses of its truth; or, lastly, whether the Author were solid and sober, or vain and light; with the like Particulars, which regulate the force of Authority^l. In the third place, Matters of no Credibility, tho yet current and famous; such as partly thro neglect, partly thro the use of Metaphors, have prevailed in many Ages; as, that the Diamond ties down the Loadstone, &c. are not to be rejected by Silence; but thrown out by express Words, that they may no longer molest the Sciences.

To note, occasionally, Vanities and Credulities.

23. It might likewise be proper to note, by the way, the Origin of particular *Vanities* and *Credulities*: such, for instance, as that a Power of exciting Venery is attributed to the Plant *Satyrium*, only because its Root is formed after the manner of Testicles: whilst the Truth only is, that a new bulbous Root grows, every Year, to the Root of the former Year; and thus makes two: as appears from hence, that the new Root is always found solid and succulent; but the old one shrunk and spongy. Whence 'tis no wonder the one should float, and the other sink in Water: which yet has been held as a strange thing; and given authority to the other supposed Virtues of this Plant.

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when this Science is applied to the solving of Phænomena, in the way of Accommodation, Hypothesis, or Supposition; it then becomes imaginary and fantastical; and seems to act out of its Office, not to the Improvement, but Subversion, of *Philosophy*: as was remarkably the Case in *Astronomy*, before the strict inductive Procedure of Sir *Isaac Newton*.

^k See the *Novum Organum*, Part I. Sect. VII. 3, &c.

^l 'Tis very remarkable, that the Author himself, and Mr. *Boyle*, by carefully observing this Rule, have incurred the Censure of *Credulity*: a Censure that has strangely spread over *Europe*; and been credulously entertained by Persons unacquainted with the exact and scrupulous Procedure of these two illustrious Philosophers. Nor is it an easy matter to recover their Characters in this respect; tho the Opinion itself is false and groundless. So little do the Bulk of Mankind distinguish, betwixt *original Report* and that at *Second-hand*, tho ever so cautiously guarded.

APHORISM IX.

24. **T**Here remain certain useful *Appendages to Natural History*, capable of *Five Appendages to this History*. fitting it more commodiously to the succeeding Business of the *Interpreter*: these are *Five* in Number.

25. And, *First*, Queries, not with regard to Causes, but Matters of *Viz. (1.) Quæries as to Facts.* Fact, are to be subjoined; to solicit and provoke farther *Enquiry*. As in the *History of the Earth and Sea*; whether the *Cassian Sea* ebbs and flows; and at what times? Whether there be any *southern Continent*, or rather *Islands*? and the like.

26. *Secondly*, In all new, and curious, *Experiments*, the manner used in making the *Experiment*, must be added; to leave the Judgment of Man-kind free, whether the Information by the Experiment be just, or fallacious: as also to excite their Industry to invent, if possible, more exact *(2.) The manner wherein Experiments were made.* Methods of Trial ^m.

27. *Thirdly*, If there arise any Doubt, or Scruple, in a Relation, it should not be concealed, or suppressed; but clearly wrote down, in the way of *Note*, or *Admonition*: for we desire this *primary History* should be compiled with the most religious and sacred regard to Truth, in all Particulars; as being the *Volume of God's Works*; and, with due reverence to *divine Revelation*, a *second Scripture*. *(3.) Notes and Admonitions.*

28. *Fourthly*, It will also be proper, after the manner of *Pliny*, sometimes to intersperse Observations; as in the *History of the Earth and Sea*, for example, that the Figure of the *Earth*, so far as we hitherto know it, with respect to the Water, is narrow and pointed to the South; but wide and spreading to the North; directly contrary to the Figure of the Waters; and that the great *Oceans* cut the Lands in wide Channels between the North and South, not between the East and West; unless perhaps in the Extremities of the polar Regions. *Canons*, also, which are no other than general and universal Observations, are justly set down; as in the *History of the heavenly Bodies*, that *Venus* is never removed above forty-seven Degrees from the *Sun*; nor *Mercury* above twenty-eight; and that the Planets above the *Sun* move slowest, when farthest from the Earth, and those below the *Sun*, swiftest ^a. *(4.) Observations, Canons, and Things that are, subjoin'd to those that are not.*

29. Another kind of *Observation* must be likewise employed, as a thing of considerable moment, tho not hitherto in Use; *viz. the subjoining to things that are, the things which are not*; as in the *History of the heavenly Bodies*, that there is no oblong or triangular Star; but that all Stars are either round, or gibbous, when shorn of their Rays; or that the Stars are placed irregularly, not in Squares, Pentagons, or other perfect Figure; and scarce any three of them in a right Line.

30. *Lastly*,

^a And thus Mr. Boyle, Dr. Hook, Sir Isaac Newton, and many of the modern Philosophers, have tried over again, verified, confirmed, and improved upon, several Experiments of the Author; as particularly those of *Sounds*, the *Microscope*, the *Thermometer*, the *Prism*, &c.

ⁿ The Reader will find these larger *Observations* and *Canons* more frequently used in the Author's Specimens of *Inductive History*, than in the *Sylva Sylvarum*. See particularly the *History of Life and Death*; and the *History of Winds*, *passim*.

(5.)
Received Opin-
ions to be
slightly
touched.

30. *Lastly*, It may be of some service to the *Enquirer*, tho a great prejudice to the *Believer*, to have the *Opinions* now received, briefly touch'd ; together with their *Varieties* and *Sects* ; and related only in *passage*, as a *Hint* to the *Understanding*, and no farther °.

A P H O R I S M X.

The Work feasible. 31.

AND so much for the *general Precepts* for compiling our *History* of *Nature* and *Experience* ; which, if carefully observed, its *End* will be duly obtained, without swelling above measure. But if, as thus limited and circumscribed, it shall still appear a vast Work to any pusillanimous Spirit ; let him cast his *Eye* upon *Libraries* ; and, among other things, consider the *Bodies* of the *Civil* and *Canon Law*, on the one side ; and the *Commentaries* of *Lawyers* and *Learned Men*, on the other ; and see what a *Difference* there is between this and that, as to bulk and number of *Volumes*. For my own part, who desire nothing more than to be a faithful *Secretary to Nature*, and to receive and copy nothing but her *Laws*, I chuse *Brevity* ; and find it in a manner imposed upon me, by the thing itself : but for *Opinions*, and *Notions*, and *Speculations*, they are without number, without end.

S E C T. II.

Containing more precise DIRECTIONS, and a Catalogue of the PARTICULAR HISTORIES, required to the true Interpretation of Nature.

More particular Directions for such as would assist in compiling the History above-mentioned.

IT were now proper to sit upon the several *Heads of Histories*, and examine *Nature*, Article by Article, what *Particulars* in each *History* should be principally enquired into, and wrote down ; as certain *Topicks*, directly conducing to the *End* above proposed : which would be to proceed in the *Great Cause*, wherein *Mankind* endeavour to recover their lost *Right* over the *Creatures*. But this is a *Work* of large extent ; which, however, we propose, in some measure, to execute ; by enquiring into several *Cardinal Virtues*, or *capital Powers* of *Nature*, in order to a just *Interpretation* of her *Works* : since we cannot promise for the *Industry* of others, upon this *Head* ; till *Men* shall have begun to cultivate a closer *Acquaintance* with *Nature*.

But

° And thus, for example, if the *History* were to be carefully continued, we should intimate, by the way, that the *Doctrine of Attraction* is frequently wrested, and injudiciously applied ; that *mathematical Calculations* are abused in numerous Instances ; and that false *Imaginations* are every where indulged, of the modern *Discoveries* ; to the prejudice and slow advancement of *universal Philosophy*.

¶ This the Author proposed to prosecute, in several Sets of *particular Enquiries*, into capital Subjects ; as the *History of Life and Death*, the *History of Winds*, the *History of Density* and Rarity,

But for more particular Directions, if any one shall desire to assist us in this *Undertaking*, we will here annex the *precise Rules* we propose to follow in the Work.

2. And *first*: As it were endless to pursue all *Subjects*, we make choice of such as are of greatest importance for Use; most convenient for quantity of *Experiments*; more difficult, and noble, for their Depth and Obscurity; or most exemplary, and extensive, on account of their Richness, or difference of *Heads* or *Titles*. The Subjects to be chose.

3. In each Subject, after a short *Introduction*, or *Preface*, we immediately lay down the particular *Topicks*, or *Heads of Enquiry*; as well to give light for the present, as to solicit a farther Search in future: for tho we are not Masters of Things, yet we are Masters of Questions. We do not, however, precisely observe the order of *Questions*, in the *History* itself; lest what was intended for a Help should prove a Hinderance. The Method of treating them.

4. *History* and *Experiments* always hold the first Place; which, if they exhibit an enumeration and series of Particulars, are thrown into *Tables*; but otherwise are set down separate. History and Experiments claim the first place.

5. But as *Histories* and *Experiments* are frequently wanting, especially those that give Light to the Enquiry, and would be *crucial Instances*; by which alone the Understanding can be satisfied of the *true Causes of Things*; we direct the making of such *new Experiments*, so far as we are able to foresee, as appear proper to determine the Question. And these Directions are the *Designations*, or *Intimations of Histories*, which is all that we can offer; as ourselves are now but just first entering the *Road of History*. When Experiments are wanting, to indicate them.

6. When several *Experiments* fall under two or more *Titles*; as in the *History of Plants*, and the *History of Gardening*, where various Particulars are common to them both; we judge the *Enquiry* is better conducted, by regarding the *Bodies*; but the Disposition by regarding the *Arts*: for we pay little regard to the *Arts themselves*; except such as conduce to the *forming of Philosophy*. But the Conduct in these Cases will occasionally be directed by the Things themselves. When Experiments come under several Heads, to regard the Matters, and not the Arts.

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Rarity; which were executed: but the *Histories* of many other things; as those of *Gravity* and *Levity*, *Sympathy* and *Antipathy*, *Salt*, *Sulphur* and *Mercury*, &c. were never published.

^b Hence the Author has shewn great Judgment, in pitching upon the *History of Life and Death*: as the Prolongation of Life, is not only an intricate and multifarious Enquiry; but of the utmost Importance to Mankind: and necessary in order to the Improvement of all other Arts and Sciences. And next to this, he cou'd not, perhaps, have made a better Choice, than in beginning the *Enquiry into Winds*; as the right management of this Power in Nature, might greatly conduce to ease the Labour of the Hand; procure Intelligence by Commerce; and lay the Foundation for many other natural Enquiries.

^c Too rigid a Method, in such Enquiries as cannot be fully prosecuted by any one Man, or any single Age, is to be avoided: for *Matter* must ever direct *Method*. And we shou'd greatly mistake the Design of the Author, to imagine he has finished any single Enquiry: all he endeavoured was but to begin them.

^d What these *Instances* are, is fully explained in the *Novum Organum*, Part II.

^e To regard Arts themselves, would be making Philosophy a Slave to present Advantage; which is a secundar Consideration: and by diverting Philosophy from its purpose, Arts themselves would be Sufferers, for when Philosophy is improved and carried to its due height, the improvement and perfection of all Arts, will follow of Consequence. And this particular ought to be well regarded; otherwise, by catching at Shadows, we shall lose the Substance.

To relate how
the Experi-
ments were
made.

To interpose
Admonitions,
Cautions, and
Glances at the
Interpretation
of Nature.

Hints at Cau-
ses.

Hints for prac-
tical Uses.

To set down
Optatives ;
or things next
to impossible.

An Invitation
for others to
assist.

7. We explain the manner observed in making all subtle or more curious Experiments ; to prevent Error, and excite others to contrive more exact, and better Methods, of verifying or confirming them.

8. We frequently interperse Admonitions and Cautions, with regard to the Fallacies of Things ; and the Errors and Scruples that may occur in the Enquiry, or Discovery : in order, as much as possible, to charm down all Fancies and false Conceits. We likewise, all along, subjoin our *Observations upon History and Experiments* ; in order to promote, and prepare, the Business of interpreting Nature.

9. We here and there interpose our Suspicions, in the way of first Outlines, towards the Explanation of Causes ; but so as rather to suggest what may be, than to determine what really is the Case.

10. We form, and set down, *Canons*, tho variable ; or imperfect and improveable *Axioms* ; which offer themselves in the business of Enquiry : but this without determining : for such *Canons*, or *Axioms*, may be useful, tho not precisely true ^f.

11. And tho Light be a nobler thing than the Objects it shews ; yet being ever mindful of the Service of Mankind, we start *Hints* of Practice, and recommend them to Men's Attention and Memory : as well knowing, that Mankind unfortunately labour under such a great degree of insensibility, as sometimes not to see, but step over, things that lye before their Feet ; unless put in mind thereof.

12. We propose, under every Subject that allows it, even Works and *Things impossible* ; at least such as are not hitherto discovered : and, at the same time, subjoin such, as being already known, and within the Power of Man, nearly approach and resemble those Impossibilities, and undiscovered Things ; in order, at once, to encourage Mankind, and excite their Industry ^g. And thus we hope, not only to furnish out, in some tolerable degree, the *third Part* of our INSTAURATION, but in good measure also to pave the way for the *fourth* and *sixth* ^h.

13. These are the *particular Rules* I purpose to follow, in compiling what part I am able, of a sound and serviceable *Natural* and *Experimental History* : which, to prosecute in its full Extent, is, as we before observed, a Work too great for a single Person ; whence we earnestly invite others to take part of the Task. For their better Direction, we will here indicate some of the *particular Histories*, which appear to us proper to be gone upon ; and subjoin a *Collection* of those we esteem the most important for the Uses of Life.

A

^f Duly to understand the Force and Use of these *particular Rules*, which the Author prescribes himself, in compiling his *History*, will give great Light into the Nature and Design of the *third, fourth, and sixth Parts* of the Grand INSTAURATION.

^g With what Judgment this Rule was form'd ; with what Skill and Address observed, by the Author ; and to what great Advantage, few will perceive that are not *Inventors*.

^h For the larger *Observations*, the *Canons*, and *Axioms*, that every where occur, were to be verified, render'd strictly just and true, in the *fourth Part* of the *Instauration*, and then directly transferr'd into the *sixth* ; so that this last, capital Part of the whole, was to be form'd in the precedent *Parts*, and only drawn out in the *sixth* ; the place destined to receive that pure, genuine and axiomatical Philosophy, which shou'd flow spontaneously from the preceding rigid and severe Enquiry.

A CATALOGUE of PARTICULAR HISTORIES,
 required for the INTERPRETATION of NATURE;
 or laying the Foundations of INDUCTIVE HISTORY.

1. **T**HE History of the Heavenly Bodies; or Astronomical History ^a.
2. The History of the Configuration of the Heavens, and their Parts, to the Earth and its Parts; or the Cosmographical History ^b.
3. The History of Comets ^c.
4. The History of fiery Meteors ^d.
5. The History of Lightning, Thunder, and Corruscations ^e.
6. The History of Winds, sudden Gusts and Undulations of the Air ^f.
7. The History of Rainbows ^g.
8. The History of Clouds, as they appear above ^h.
9. The History of the blue Expanse, the Twilight, mock-Suns, mock-Moons, Halo's, the various Colours of the Sun and Moon, and of all the variety of appearances in the Heavenly Bodies, with regard to the Medium ⁱ.

D 2

10. The

^a The Author himself begun this; in his *Essay toward a Philosophical History of the Heavens*. See the *ninth Supplement* to the *de Augmentis Scientiarum*. It has been continued by numerous Writers, tho not precisely in his own manner. Among the principal are Mess. Hevelius, Tacquet, de la Hire, Sir Isaac Newton, Mr. Flamsteed, Dr. Gregory, and Dr. Halley.

^b The Design of this History seems, in some degree, superseded, by the later Discoveries; which shew the Configuration of the Heavens to be Optical, or depending upon the Nature of Vision. But the Author's meaning will be better understood, by his *Specimen of animated Astronomy*. See the *ninth Supplement* to the *de Augmentis Scientiarum*.

^c The History of Comets is largely prosecuted by Lubienicius, in his *Theatrum Cometicum*; but more satisfactorily by Hevelius, in his *Prodromus Cometicus*, and *Cometographia*. For the Theory of the Comets, see Sir Isaac Newton's *Principia*; Dr. Gregory's *Astronomy*; and Dr. Halley's Paper upon the *Astronomy of Comets*, in the *Philosophical Transactions*, N^o 297.

^d See Dr. Halley, Mr. Whiston, and several Papers in the *Philosophical Transactions*, upon the *Aurora Borealis*. See also Morhof's *Polyhistor*, Tom. II. Cap. 24. de *Meteoris Igneis*.

^e There are some Papers upon this Subject in the *Philosophical Transactions*.

^f See the Author's History of Winds, and Mr. Bohun's Discourse concerning the Origin and Progress of Wind; printed at Oxford, 1671. See also the *Philosophical Transactions*; and Morhof, de *Meteoris Aereis*.

^g The Foundation of this History seems laid by des Cartes, the Archbishop of Spalato, Sir Isaac Newton, and M. Huygens, de *Coronis & Parhelii*. See also Marcus Marci de *Arcu caelesti*; printed at Prague in 1648. and Grimaldi's *Physico-Mathesis, de Lumine, Coloribus, & Iride*. Ed. Bononiae 1665. M. Mariotte, des *Couleurs*, &c.

^h For the later Writers upon this Subject, See Morhof's *Polyhistor*, Tom. II. Cap. 27. de *Meteoris Aquaeis*.

ⁱ The Foundations of this History are laid in Sir Isaac Newton's *Treatise of Opticks*. And for other Writers upon it, See Morhof, de *Iride, ac reliquis Meteoris emphaticis*; and the *Philosophical Transactions*.

10. *The History of common Rain, stormy Rain, prodigious Rains, Cataracts, Spouts^k, &c.*
11. *The History of Hail, Snow, Frost, Hoar-frosts, Mists, Dews^l, &c.*
12. *The History of all other Bodies, descending from, or generated above^m.*
13. *The History of Sounds in the upper Regions; if there be any besides Thunderⁿ.*
14. *The History of the Air, considered as a whole; or with regard to the Configuration of the World^o.*
15. *The History of Seasons, or Temperatures of the Air; both with regard to the difference of Countries, the accidents of Times, and the periods of Years; as also of Inundations, Heats, Droughts, and the like^p.*
16. *The History of the Earth and Sea; their Figure, Circumference, and Conformation to each other; with their Order of Extension, as to breadth or narrowness; of the Islands, and Bays of the Sea; Salt Lakes in the Earth; Istmus's, Promontories^q, &c.*
17. *The History of the Motions of the terraqueous Globe, and of the Experiments to be made for determining the same^r.*
18. *The History of the greater Motions and Perturbations in the Earth and Sea; Earthquakes, Tremblings, Chasms, New-Islands, Floating-Islands, Breaches by the Entrance of the Sea, drowning of Lands, Wastes deserted by the Sea, fiery Irruptions from the Earth, sudden Irruptions of Water from the Earth^s, &c.*
19. *The Natural Geographical History of Mountains, Valleys, Woods, Plains, Deserts, Meers, Lakes, Rivers, Torrents, Springs; with all the diversities of their Origin, and the like; exclusive of Nations, Provinces, Cities, and other civil Considerations^t.*
20. *The History of the Flux and Reflux of the Sea, its Alternations, Undulations, and other Motions^u.*

21. *The*

^k The Royal Society of London, and the Royal Academy of Paris, appear to be collecting together numerous Observations, made in different Parts of the World, with relation to this Subject. See the *Philosophical Transactions*, and *French Memoirs*. See also Bohun of Wind, and Morhof, *de Meteoris Aqueis*.

^l Mr. Boyle's *Philosophical Works*, the *Philosophical Transactions*, and the *French Memoirs*, contain many Particulars relating to this History. See likewise Morhof, *de Meteoris Aqueis*.

^{m n o p} See Mr. Boyle's *Memoirs for a general History of the Air*; Morhof's *Polyhistor, de Aere*, and Boerhaave's *Chemistry*, in the Chapter of Air.

^{q r s} These several Histories are prosecuted by Varenus, in his *Geographia Generalis*. See Dr. Jurin's Edition of that Work; printed at Cambridge, 1712.

^t See the *Philosophical Transactions*; and several of Mr. Boyle's *Philosophical Pieces*.

^u See *Possius de Motu Marium*; Dr. Wallis's Hypothesis about the Flux and Reflux of the Sea, in the *Philosophical Transactions*; Sir Isaac Newton's *Principia Philosophiæ Naturalis Mathematicæ*; and Morhof's *Polyhistor*, Tom. II. Cap. 20. *de Mare*, &c.

21. *The History of other accidents of the Sea ; its Saltness, diversity of Colour, Depth ; and of the submarine Regions, Rocks, Mountains, Valleys* ^v, &c.

II.

THE HISTORIES OF THE ELEMENTS, OR GREATER ASSEMBLAGES OF MATTER.

22. *The History of Flame, and Bodies ignited* ^w.
 23. *The History of Air, in Substance, not Configuration* ^x.
 24. *The History of Water, in Substance, not Configuration* ^y.
 25. *The History of Earth, and its diversity, in Substance, not Configuration* ^z.

III.

THE HISTORIES OF PARTICULAR SPECIES.

26. *The History of the perfect Metals, Gold and Silver ; with their Ores, Veins, Marcasites ; and the ways of working them from the Mine* ^a.
 27. *The History of Quicksilver.* ^b
 28. *The History of Fossils ; as Vitriol, Sulphur* ^c, &c.
 29. *The History of Gems ; as the Diamond, the Ruby* ^d, &c.
 30. *The History of Stones ; as Marble, Flint* ^e, &c.
 31. *The History of the Loadstone* ^f.

32. *The*

^v See Mr. Boyle of the *Submarine Regions* ; and the *Saltness of the Sea* : and Count Marfigli's *Natural History of the Danube, and of the Sea*.

^w Mr. Boyle has touched upon this Subject, in his *Treatises of Phosphori*, and the *Ponderability of Fire and Flame*.

^x See Mr. Boyle's *Memoirs for a Natural History of the Air*.

^y See Mr. Boyle's *Philosophical Works*, passim ; Boerhaave's Chapter of *Water*, in his *New Method of Chemistry* ; and Morhof's Chapter *de Aqua*, in his *Polyhistor*, Tom. II. Cap. 19.

^z Mr. Evelyn has treated this Subject, in his *Terra*. For other Writers upon it, consult Morhof's *Polyhistor*, Tom. II. Cap. 21. *de Terra*.

^a For the Writers in this way consult Webster's *Metallographia* ; but some of the principal are Alonso Barba, Lazarus Ercker, Glauber, Kunckel, Becker, and Stahl.

^b Georg. Agricola began this History, in his Work *de re Metallica* ; and the Authors last mentioned have continued it. There are also some Papers upon this Head in the *Philosophical Transactions*.

^c See Boerhaave's *Chemistry* ; Stahl's several *Chemical Pieces* ; Dr. Woodward on *Fossils* ; and the *Philosophical Transactions* : but a capital Work in this way, is Michael. Mercati *Metallorheca*, published at Rome, with Notes, by Johan. Mar. Lancisi, Anno 1717. See also Morhof's *Polyhistor*, Tom. II. Cap. 29. *de Mineralibus in genere*.

^d Mr. Boyle has an express Treatise upon this Subject ; and for other Writers upon it, see Morhof's *Polyhistor*, *de Lapidibus, eorumque Generatione*, &c. Tom. II. Cap. 30.

^e Mr. Boyle has some curious Observations, up and down his *Philosophical Works*, relating to this Subject. See also Dr. Lister, Dr. Woodward, and the other Writers of *Natural History*.

^f The Subject of the Loadstone is treated by Kircher, Mr. Boyle, the *Philosophical Transactions*, Mr. Whiston, and many more.

32. *The History of miscellaneous Bodies, neither perfectly Mineral, nor perfectly Vegetable; as Salt, Amber, Ambergrease^g, &c.*
33. *The Chemical History of Metals and Minerals^h.*
34. *The History of Vegetables, Trees, Shrubs, Plants, and their Parts; as Roots, Trunks, Woods, Leaves, Flowers, Fruits, Seeds, Droppings, Tears, Weepingsⁱ, &c.*
35. *The Chemical History of Vegetables^k.*
36. *The History of Fish, their Parts, and manner of Generation^l.*
37. *The History of Birds, their Parts, and manner of Generation^m.*
38. *The History of Beasts, their Parts, and manner of Generationⁿ.*
39. *The History of Serpents, Worms, Flies, and other Insects; their Parts, and manner of Generation^o.*
40. *The Chemical History of animal Matters^p.*

IV.

THE HISTORIES RELATING MORE IMMEDIATELY TO MAN.

41. *The History of the Figure, and external Parts of Man; his Stature, Conformation, Countenance and Lineaments; with the Varieties thereof, according to Nation, Climate, or other smaller Differences^q.*
42. *The History of human Physiognomy, to be drawn from the foregoing^r.*
43. *The*

^g The later Writers of *Natural History* treat also of these. See *Morhof's Polyhist.* Tom. II. Cap. 37. *de Mediis Mineralibus.*

^h See *Becher, Kunkel, Stahl*, and *Boerhaave*, in their Chemical Pieces.

ⁱ *Mr. Ray's Historia Plantarum*, *Dr. Grew's Anatomia Plantarum*, *Malpighi's Anatomia Plantarum*, and several Papers in the *German Ephemerides*, nobly prosecute this Subject, in particulars.

^k A Method is chalk'd out, and a Foundation laid, for this *History*, in *Boerhaave's Chemistry*, and some of *Mr. Boyle's Pieces*; as particularly his *History of human Blood*.

^l *Hermanus Conringius* has collected all the Authors, both ancient and modern, that treat of this Subject. See also *Willoughby's Ichthyologia*.

^m See *Willoughby's Ornithologia*, the *Philosophical Transactions*, and *Morhof's Polyhist.* Tom. II. Cap. 46. *Miscella quædam de Animalibus.*

ⁿ See *Dr. Harvey, de Generatione Animalium*, *Kerkringius's Anthropogenia Icnographia*; the *French Memoirs*; and particularly the *Memoires de l'Academie Royale, pour servir à l'Histoire des Animaux*. See also *Morhof, Polyhist.* Tom. II. Cap. 45.

^o See *Aldrovandus, Sam. Bochart, Hook, Swammerdam, Rædi, Andry, Malpighi, &c.*

^p *Boerhaave* has reduced this Subject to a just Method; and put it in the way of a proper Treatment. See the Processes upon Animals, in his *Chemistry*.

^q The *Chinese* appear to have cultivated this Subject more than the *Europeans*, even so far as from thence to form a Judgment of Men's Morals; their Guilt or Innocence, in Criminal Cases, &c. See *Wolfsius upon the Chinese Philosophy*, and the *Missionaries Letters*. Consult also *Camillus Baldus upon Aristotle's Physiognomica*; as likewise his *Pieces de humanarum Propensionum ex temperamento Prænotionibus, &c.* Ed. Bononia, 1664. & *Scip. Clermont, de Conjectandis latentibus animi affectibus.*

^r See the *Characters of Theophrastus*, with *Casaubon's Notes*; *Morhof de Artibus divinatoriis & Magia*, in *Polyhist.* Tom. II. Lib. III. and *Mr. Evelyn's Appendix to his Discourse upon Medals.*

43. *The History of human Anatomy ; or, of the internal Parts of Man ; with their Variety found in the natural Structure and Conformation ; and not only as preternaturally altered by Accident or Diseases^c.*
44. *The History of the similar Parts of Man ; as the Flesh, Bones, Membranes^d, &c.*
45. *The History of the Humors in Man ; the Blood, the Bile, the Seed^e, &c.*
46. *The History of the human Excrements ; the Saliva, the Urine, the Sweat, the Fæces, the Hair of the Head, the Hair of the Body, the Nails, the Skin of the Nails^f, &c.*
47. *The History of the Faculties of the Body ; Attraction, Digestion, Retention, Expulsion, Sanguification, Assimilation of the Aliment into the Parts of the Body, and the Conversion of Blood, and the fine part thereof, into Spirit^g, &c.*
48. *The History of natural and involuntary Motions ; as those of the Heart, the Pulse, the Lungs, Sneezing, Yawning, Erection of the Penis^h, &c.*
49. *The History of the mixed Motions, compounded of natural and voluntary ; as Respiration, Coughing, the making of Urine, going to Stoolⁱ, &c.*
50. *The History of voluntary Motions ; as, of the Organs of Speech, the Motions of the Eyes, the Tongue, Jaws, Hands, Fingers, Throat in swallowing^j, &c.*
51. *The History of Sleep and Dreams^k.*
52. *The History of the various Habits of the Body ; as to Fat, Lean, Complexion, Constitution^l, &c.*

53. *The*

^c These Subjects have been diligently prosecuted by the *Modern Anatomists*, in all the solid Parts of the Body, thus Dr. *Willis* and *Malpighi* have carefully traced and anatomized the Brain, and Nerves; *Sieno* the Muscles; *Bellini* and *Malpighi* the Tongue; *Casilius Folius* and *du Verney* the Ear; *Bartholin* the Lungs; *de Graaff* the Parts of Generation; *Havers* the Bones, &c. A summary History of all which is given us by *Boerhaave*, in his *Institutiones Medicae*. 'Tis pity but the *History of the Animal Fluids* were extant with equal exactness.

^d This *History* is almost deficient, and requires a particular Chemical and Philosophical Treatment. Mr. *Boyle's* History of human Blood; and *Boerhaave's* Processes upon Animals, may pave the way for it.

^e This *History* also seems, in a manner, untouched: *Boerhaave*, in his *Institutiones Medicae*, has collected the sum of what has been done upon it. See also *Merkhof's Polyhist.* Tom. II. Lib. II. Cap. 47. *de Homine*.

^f Neither has this Subject been prosecuted as it deserves; but *Boerhaave* has made great use of the present Discoveries, to shew it to Advantage, in his *Institutiones Medicae*.

^g See the whole of these Doctrines, so far as they are known at present, aphoristically deduced in *Boerhaave's Institutiones Medicae*.

^h The *History of Dreams* seems still deficient; tho an Enquiry worthy the Prosecution. But the Foundations for the History of Sleep are laid by *Boerhaave*, in the Treatise abovemention'd,

ⁱ Nothing very considerable seems hitherto done, towards furnishing out this *History*.

53. *The History of human Generation* ^c.
54. *The History of human Conception, Quickening, Gestation, Birth* ^d, &c.
55. *The History of human Alimentation, all kinds of Eatables, Drinkables and Diet; with their Variety, according to the difference of Nation, or lesser Matters* ^e.
56. *The History of the Growth and Increase of the human Body, both in the Whole, and its Parts* ^f.
57. *The History of human Age, Infancy, Childhood, Youth, old Age, long Life, short Life, &c. according to different Nations, and lesser Differences* ^g.
58. *The History of Life and Death* ^h.
59. *The medicinal History of Diseases, with their Signs and Symptoms* ⁱ.
60. *The medicinal History of Curation, Remedies, and Relief from Distempers* ^k.
61. *The medicinal History of such things as preserve the Body in a healthy State* ^l.
62. *The medicinal History of such things as regard the gracefulness and comeliness of the Body* ^m, &c.
63. *The medicinal History of such things as change the Body, and belong to an alterative Regimen* ⁿ.
64. *The History of Pharmacy* ^o.
65. *The*

^c This has been prosecuted, tho not advanced to perfection; for it still remains undetermined, whether Generation is performed by means of the *Animalcula in femine Masculino*, or not: tho the general Opinion seems to favour the affirmative.

^d The Business of Conception and Quickening remains to be farther enquired into; nor, perhaps, are the best Methods of delivering Women in *difficult Births* hitherto discovered.

^e This Subject has not been satisfactorily prosecuted; but Dr. *Arbutnot* very lately shew'd how the Enquiry might be conducted to Advantage, in his *Discourse of Aliments*.

^f Some Mechanical Attempts have of late been made to deduce this History; but not, perhaps, with that Care and Exactness the Subject requires.

^g There seems to be little satisfactory, or useful, extant upon this Subject.

^h The Foundations for this History are firmly laid by the Author, in his particular Enquiry into *Life and Death*: but certainly the Subject has not been duly prosecuted since, as its importance requires. See *Morhof, Polyhist.* Tom. 1. Lib. II. Cap. 5. *de Tempore*.

ⁱ ^k How little that is solid and useful, has been done towards these two Histories, may appear from the *Aphorisms of Boerhaave, de Cognoscendis & Curandis Morbis*; which are a Summary of the ancient and modern Doctrine upon the Subject. See also *le Clerc's Histoire de la Médecine*.

^l Nothing in *Medicine* is, perhaps, more wanted than this History; especially with regard to *Heat and Cold*, and other external and internal Causes of Distempers. See *Quincy's* Edition of *Sanctorius's Aphorisms*; *Keil's Tentamina Medica*; and *Wainwright* on the *Non-Naturals*.

^m This History also is, in great measure, deficient.

ⁿ The Author affords some Notices for this History, in his Enquiry into *Life and Death*: but they appear to have been little regarded.

^o The History of Pharmacy is by no means extant, in the manner required by the Author; that is in the aphoristical manner: with a due rejection of uncertainties, superfluities, phantastical Traditions, ill-grounded Opinions, &c. But for bulkiness and number of Writers, it may rival most other Histories.

65. *The History of Chirurgery* ^a.
66. *The chemical History of Medicines* ^o.
67. *The History of Sight, and visible Objects* ^p.
68. *The History of Painting, Sculpture, Statuary* ^q, &c.
69. *The History of Sounds, and Hearing* ^r.
70. *The History of Musick* ^t.
71. *The History of Odours, and the Smelling* ^c.
72. *The History of Tastes, and Tasting* ^u.
73. *The History of the Touch, and its Objects* ^v.
74. *The History of the Act of Venerly, as a Species of Touch* ^w.
75. *The History of bodily Pains, as a kind of Touch* ^x.
76. *The History of Pleasure and Pain in general* ^y.
77. *The History of the Passions; as, Anger, Love, Bashfulness* ^z, &c.
78. *The History of the intellectual Faculties; as Thought, Imagination, Reasoning, Memory* ^a, &c.
79. *The History of natural Divinations* ^b.
80. *The History of Discernments, or occult natural Judgments* ^c.

VOL. III.

E

81.

^a The *History of Chirurgery* seems prosecuted more carefully than Pharmacy, and reduced to a tolerable Simplicity; tho capable, perhaps, of much greater Certainty, and farther Improvement. See the present Summary of its Doctrine, in *Boerhaave's Aphorisms de Cognoscendis & Curandis Morbis*.

^o Materials for this *History* are extant in great Variety; but they require Verifying and Rectifying. See a Summary of it, as it stands at present, in *Boerhaave's Chemistry*.

^p The Foundation for this *History* is laid by Dr. Hook, in his *Micographia*; Leeuwenhoek, in the *Philosophical Transactions*; Mr. Molyneux, in his *Dioptricks*; Sir Isaac Newton, in his *Treatise of Light and Colours*; Barrow's *Lectiones Opticae*; and Gregory's *Elementa Dioptricae & Catoptricae*.

^q For this *History* consult, among others, Gerard de Laireffe, in his *Principes du Dessin*, Amsterdam. 1718. Felibien's *Entretiens sur les Vies, & sur les Ouvrages des plus excellents Peintres*; or his *Abregé de la Vie des Peintres*, printed at Paris in 1715.

^r This *History* is prosecuted by Mr. Boyle; the *Philosophical Transactions*; French Memoirs, and many of the modern Writers.

^t Mr. Malcolm seems to have begun the *History of Musick*, in the solid rational Way intended by the Author. See Mr. Malcolm's *Treatise of Musick, speculative, practical, and historical*; printed at Edinburgh. 1721.

^u Mr. Boyle has laid the Foundations for these *Histories*, in his *Enquiry into the Origin of Forms and Qualities*; and the several subsequent Pieces to that leading Enquiry. See also Morhof's *Dissertatio de Paradoxis Sensuum*.

^w The Author has somewhat upon this Head, in his following Piece, or, *Sylva Sylvarum*. And the learned Jacob. Thomassius wrote a Dissertation, *De Sensu Sexto, sive Tuillatione Venerea*.

^x This useful Subject seems to remain uncultivated, except a little by Physicians.

^y The physical Enquiry into Pleasure and Pain seems to be much neglected, tho a Matter of great importance.

^z See Des Cartes, M. Senault, and Mr. Hutchinson, upon the Passions.

^a Mr. Locke's *Essay upon Human Understanding*, may seem to have begun this *History*; to which add Father Malbranche's *Recherche de la Verite*, and the several Pieces of Mr. Berkeley.

^b Consult upon these Heads, Morhof's *Polyhist.* Tom. II. Lib. III. *De Artibus Divinatoriis, & Magia*.

81. *The History of Cookery, and the Arts subservient to it ; as that of the Graſier, the Butcher, the Poulterer^d, &c.*
82. *The History of Bread, Paſtery, and Baking, with the Arts ſubſervient thereto ; as the grinding of Flower^e, &c.*
83. *The History of Wines^f.*
84. *The History of the Cellar, and different kinds of Drinks^g.*
85. *The History of Confectionary Wares^h.*
86. *The History of Honeyⁱ.*
87. *The History of Sugar^k.*
88. *The History of the Dairy^l.*
89. *The History of the Bagnio ; as ſweating, bathing, and anointing the Body^m.*
90. *A miſcellaneous History with regard to neatneſs and elegance of the Body ; as of Depilatories, Perfumesⁿ, &c.*
91. *The History of working in Gold ; with the Arts thereto ſubſervient^o.*
92. *The History of working in Wool ; with the Arts thereto belonging^p.*
93. *The History of working in Silk ; with the Arts thereto belonging^q.*

94.

^{d e} There ſeems to be little extant upon theſe Subjects, in the true physical Way ; or that of natural Enquiry.

^{f g} Theſe Subjects have been proſecuted by ſeveral ; but ſtill there remain ſuch conſiderable things to be done, by means of a few ſlight Improvements therein, as few would credit, except Eye-witneſſes. See Baccius's *Hiſtoria Natalis Vinorum* ; Sackius's *Ampelographia* ; Hauptman de *inſignibus Viticultura Erroribus* ; Roſa's *Engliſh Vineyard vindicated* ; the *Mystery of Vintners* ; the *Vinetum Britannicum* ; Willis de *Fermentatione* ; Meibomius de *Cereviſiis* ; Glauber's Works ; Boerhaave's *Chemistry* ; and Stahl's *Zymotechnia Fundamentalis*.

^h This *History* ſeems, in a manner, deficient ; and muſt be derived from the *History* of Sugar.

ⁱ This *History* of Honey, ſhould include not only the ways of collecting the Honey ; but alſo the Manufactures thereof, into potable Liquors, Preserves, Medicines, Sugars, &c. which has ſcarce been touched upon ; tho a Subject of great Utility. Glauber has given Intimations about it ; but there are few who regard them.

^k The physical *History* of Sugar deſerves to be reckoned a capital Thing ; as capable of affording great Advantages to Mankind in general, and more particularly to the Inhabitants of England. The Author ſeems apprized of it, and, in his *Sylva Sylvarum*, expreſſly recommends an Experiment to be made upon this Subject ; which, in ſkillful Hands might prove immenſely ſerviceable. See Piſo's *History* of the Indies ; Barlai *Descriptio Rerum ſub Mauritio in Braſilia geſtarum* ; Angel. Sala *Saccharologia* ; Mr. Boyle on the Uſefulneſs of Natural Philoſophy ; Sir Hans Sloan's *Natural History* of Jamaica ; Dr. Slare on Sugar ; Dr. Stahl's *Zymotechnia Fundamentalis* ; and his *Philosophical Principles* of Chemistry.

^l This has been but little conſider'd, by the profeſſed Naturaliſts and Philoſophers, tho worthy of their Attention. Some chemical Operators have a way of diſtilling Brandy from Whey and Buttermilk.

^m Some Attempts have been made, by the Moderns, to revive the ancient Practices in theſe Particulars ; but the Subject has not been duly cultivated, and improved, as it deſerves.

ⁿ Tho it were eaſy to proſecute this *History*, yet, perhaps, little conſiderable has been done in it by the Moderns.

^{o p q r ſ t u v w x y z a b c d} Theſe ſeveral *Histories* are but imperfectly extant ; and ſome of them ſcarce touched upon. Memoirs for them may be found in the *Philosophical Transactions* ; the *French Memoirs* ; the *German Ephemerides* ; Morhof's *Polyhiſtor* ; the Writers of

94. *The History of working in Flax, Hemp, Cotton, Hair, Bristles, and other Substances affording a Thread; with the Arts thereto belonging* ^r.
95. *The History of working in Feathers* ^r.
96. *The History of Weaving; with the Arts belonging to it* ^r.
97. *The History of Dying* ^v.
98. *The History of working in Hides, Skins, and Leather; with the Arts thereto subservient* ^v.
99. *The History of Beds, Ticks, Down, and Feathers* ^w.
100. *The History of working in Iron* ^x.
101. *The History of Stone-cutting* ^y.
102. *The History of Bricks and Tiles* ^z.
103. *The History of Pottery* ^a.
104. *The History of working in Plaister of Paris, Terras, and Cements* ^b.
105. *The History of working in Wood* ^c.
106. *The History of working in Lead* ^d.
107. *The History of Glass, Glasing, and all vitrious Bodies* ^e.
108. *The History of Architecture in general* ^f.
109. *The History of Carriages, Coaches, Waggon, Litters* ^g, &c.
110. *The History of Printing, Writing, Sealing, Book-making, Ink, Pens, Paper, Parchment* ^h, &c.
111. *The History of Wax, natural and artificial* ⁱ.
112. *The History of Twig-works; or the making of Osier Baskets* ^k, &c.
113. *The History of Mat-work; or the pleating, weaving, and working of Straw, Rushes* ^l, &c.
114. *The History of the Laundry; all kinds of cleansing, scouring* ^m, &c.

E 2

115.

of *Natural History*; and the Writers upon new chemical Discoveries; as, particularly, *Glauber, Becher, Kunckel, Homberg, and Stahl*. But the due Execution we expect from the illustrious *Academy of Sciences at Paris*.

^c The *History of Glass* has been laudably prosecuted by *Neri, Merret, and Kunckel*, in a regular Series after one another; the two latter adding their *Notes and Improvements* upon the former: a Method deserving of Imitation in other *Histories of Arts*. See also *Blancour's Art of Glass*.

^f *Architecture* has of late been considerably cultivated: the Foundations of it are laid by *Sir Henry Wotton*, in his *Elements of Architecture*; *M. Perrault's Architecture generale de Vitruve, reduite en Abregé*; *Leo Baptista de Albertis, de Re Edificatoria*; and *Felicien's Entretiens Historiques de la Vie & des Ouvrages des plus celebres Architectes*.

^g The modern Writers in *Mechanicks* have prosecuted this Subject; particularly certain Members of the *Royal Academy of Sciences at Paris*. See also *Bishop Wilkins's Dadalus*; *Dr. Hook's mechanical Pieces*; *Wolff's Elementa Matheseos*; and the Writers of *Courses of Experimental Philosophy*.

^b See the first Rudiments of this History in *Morhof, Struvius, and Stollius*.

ⁱ See the History of *Wax*. in the Writers on *Drugs*; as *Pomet, Lemery, and Savary's French Dictionary of Commerce*; but for the History of *Wax-chandlery*, I have not met with it; tho there are some Materials to be collected for it from *Salmon's Polygraphice*, and the other Writers of artificial Curiosities.

^{k l m} I do not find these *Histories* extant, in any tolerable Perfection.

115. *The History of Agriculture, Pasturage, Wood-lands* ⁿ, &c.
116. *The History of the Garden, or Horticulture* ^o.
117. *The History of Fish-ponds, and the breeding of Fish* ^p.
118. *The History of Hunting and Fowling* ^q.
119. *The History of War, and the Arts subservient to it; as Armory, Bow-making, Arrow-smithery, Gun-smithery, Gun-foundery, Fortification* ^r, &c.
120. *The History of Navigation, with all the practical parts thereof, and the Arts thereto belonging* ^s.
121. *The History of Fencing, Wrestling, and all kinds of manly Exercises* ^t.
122. *The History of Horsemanship* ^u.
123. *The History of Sports, of all kinds* ^v.
124. *The History of Juggling, slight of Hand, and feats of Activity* ^w.
125. *A miscellaneous History of various artificial Matters; as Enamels, Pastes, Cements* ^x, &c.
126. *The History of Salts* ^y.

127.

ⁿ Many Materials for this History are collected in the *Philosophical Transactions*, and the *French Memoirs*. For particular Writers upon the Subject, See *Morhof's Polyhist.* Tom. II. Part. II. Cap. 40. *de Plantis & Vegetatione*. Cap. 41. *de Propagatione & Melioratione Plantarum*, &c. See also Mr. Evelyn and Dr. Bradley, upon the Subject.

^o This Subject has been considerably cultivated of late. See the Author's last mentioned; *Sharrock's History of the Propagation and Improvement of Vegetables*; Sir *Kenelm Digby* of Vegetation; Dr. *Laurence* on Gardening; Mr. *Hales's Vegetable Staticks*; and Mr. *Miller's Gardener's Dictionary*.

^p This Subject has rather fallen under the Treatment of Sportsmen, than Philosophers. See, however, *Rondeletius*, and *Salvianus, de Aquatilium Animalium Historia*; and *Conringius's Collection of the Writers on this Head*. The *Philosophical Transactions*; the *French Memoirs*; Mr. *Boyle's*, and Mr. *Ray's* philosophical Pieces, and *Willoughby's Ichthyologia*, likewise afford many Particulars to this Purpose.

^q See the *Scriptores Rei accipitrariae*, published at Paris in 1612; and *Paulus Merula's Dutch Treatise* of all kinds of Hunting; also the *French Venerie Royale*; and *Johan. Caii Liber de Canibus Britannicis*.

^r The Writers upon this Subject are numerous; but a capital one is, *Gabriel Naudé de Studio Militari*, Ed. Romæ, 1637. See also *Schelius ad Castra Polybiana*; and *Wolfii Brevis Commentatio de Scriptis Mathematicis*, at the End of his *Elementa Matheos Universæ*. See also Father *Aquino's Lexicon Militare*, printed at Rome 1724.

^s This Subject is profecuted, in a large Volume, by *Mynheer Wissen*, in Low Dutch; and might well deserve to be made English.

^t See Sir *William Hope's New Method of Fencing*; *M. Thibaut's Academie de l'Épée*; *Morhof's Polyhist.* Tom. II. Lib. IV. Sir *Thomas Parkyn's Inn-Play*; or, *Cornish-Hug Wrestler*; *Petter*, the Vintner of *Amsterdam*, in his Dutch Book printed at Amsterdam, 1674. But these Subjects require to be more physically considered.

^u See *M. Sorel*; the *Farrier's Guide*; *Gibson's Method of dieting Horses*, &c.

^v The Writers in this Way are numerous, and within every one's Observation; but the physical History of Sports seems to be still wanting.

^w The common Books upon these Subjects are not the things here intended: as being deficient in describing the particular Methods of training up, and habituating the Body, by proper Exercises, for Tumbling, Rope-dancing, &c.

^x See *Neri*, *Merret*, *Kunckel*, and *Blancourt*, upon the Art of Glafs.

^y Mr. *Boyle*, Sign. *Guglielmini*, *M. Homberg*, and Dr. *Stahl*, may seem to have laid the Foundations of this History.

127. *A miscellaneous History of various Machines and Motions* ^z.

128. *A miscellaneous History of common Experiments, not yet formed into Arts* ^a.

The *Histories* of pure Mathematicks should also be written; tho these require Observation rather than Experiment. We therefore set down

129. *A History of the Natures and Powers of Numbers* ^b.

130. *A History of the Natures and Powers of Figures* ^c.

A CATALOGUE of Capital ENQUIRIES regarding the more immediate SERVICE OF MANKIND.

1. **A**N Enquiry into the Ways of prolonging Life ^a.
2. An Enquiry into the Means of restoring Youth in some degree ^b.
3. An Enquiry into the Methods of retarding old Age ^c.
4. An Enquiry into the ways of curing Diseases accounted incurable ^d.
5. An Enquiry after more easy and less loathsome ways of Purging ^e.
6. An Enquiry into the Ways of increasing the strength and activity of the Body ^f.
7. An Enquiry into the Ways of mitigating Pain, and increasing the human Ability for enduring Torture ^g.
8. An Enquiry into the Ways of altering the Constitution, or Habit of the Body; as to Corpulency, Leanness ^h, &c.
9. An Enquiry into the Ways of altering the Statures of Men ⁱ.
10. An Enquiry into the Ways of altering the human Features ^k.

II. An

^z See the several Writers upon *Mechanicks*; as, particularly, *M. Varignon*, and *Wolffii Elementa Matheſeos Univerſa*.

^a Numerous Experiments of this kind occur among the *chemical Writers*; more eſpecially in the philoſophical and chemical Pieces of *Mr. Boyle*, *Beecher*, *Kunckel*, *Glauber*, *Hemberg*, *Stahl*, *Hoffman*, and *Boerhaave*.

^b See the *French Memoirs*; the *Mathematical Pieces* in the *Philoſophical Tranſactions*; and the numerous modern Writers in *Mathematicks*; particularly *Mr. Malcolm's* late Work, entitled, *A new System of Arithmetick, theoretical and practical*.

^c See the later *Mathematicians*; and, particularly, *Wolffius's Elementa Matheſeos Univerſa*.

^{a b c} Theſe Enquiries the Author himſelf has begun, after his own Method of Induction, in the *History of Life and Death*: but who has followed him, in the ſame Method, upon theſe important Articles?

^d The Attempts hitherto made to this purpoſe have been but feeble, and no way anſwerable to the importance of the Subject; which is attended with more Difficulties than properly belong to it.

^e This Enquiry might now be cut ſhort; by a prudent Uſe and Treatment of ſome *Mineral Purging Waters*, and a more judicious Management of the purging Simples. But here, again, more Difficulties are to be encountered, than naturally grow out of the Subject.

^{f g} Theſe noble Enquiries ſeem to lie neglected; perhaps thro' an untimely Deſpondency, that little can be effected in them: yet the ancient *Athleticks*, and the *Spartan Diſcipline*, might reach us better.

^{h i k} By a ſtrange Fatality, Phyſicians proceed as if theſe kind of Enquiries did not belong to their Art; which can never receive any great Improvement, whiſt it moves in ſo narrow a Sphere.

11. *An Enquiry into the Ways of improving and exalting the intellectual Powers, or faculties of the Mind*¹.
12. *An Enquiry into the Ways of converting Bodies into one another*^m.
13. *An Enquiry into the Ways of producing new Species of Bodies*ⁿ.
14. *An Enquiry into the Methods of transplanting one Species of Bodies into another*^o.
15. *An Enquiry after new Instruments of Destruction, in the way of War, Poison*^p, &c.
16. *An Enquiry into the ways of exalting the Spirits, and bringing them to good Temper*^q.
17. *An Enquiry into the Ways of working by the force of Imagination*^r.
18. *An Enquiry into the Ways of accelerating the time in Maturation, Clarification, Putrefaction, Vegetation, and Assimilation*^s.
19. *An Enquiry into the best, and cheapest, Methods of making rich Composts for Land*^t.
20. *An Enquiry into the Ways of operating upon the Air, as to the raising of Winds, Tempests, and governing the Weather*^u.
21. *An Enquiry into the Ways of procuring great Alterations in Bodies, with regard to Hardness, Softness, Fluidity, Firmness*^v, &c.
22. *An Enquiry after the Methods of turning crude and watery Substances, into oily and unctuous ones*^w.

23.

¹ See Sir Henry Wotton's *Survey of Education*; Mr. Locke on *Education*; and Morhof's *Polyhist.* Tom. I. Lib. I. Cap. XV. de *Conversatione Erudita*; & Lib. II. Cap. I. de *Delectu Ingeniorum*, & Cap. II. de *Officiis bonarum mentium*; & Cap. III. de *Facultatibus animi Subsidiis*; & Cap. IV. de *Subsidiis dirigendi Judicii*.

^{m n o} The generality of Philosophers seem to lie under a kind of Incantation, with regard to these Subjects; and instead of enquiring diligently into them, make almost the bare mention of Transmutations, and new Productions, criminal: tho at the same time such things are effected, by ordinary Operators, every Day.

^p Some may imagine, that this Enquiry lies too open: it is certain that many extraordinary things might be effected in this Way; and natural Enquiries must not stop, because they are capable of being converted to bad Purposes. See Boerhaave's *Chemistry*; of the *Ends and Uses of the Art*.

^q This capital Enquiry also lies uncultivated.

^r That some extraordinary Effects are producible in this Way, must have come within every one's Observation; and yet, who has duly prosecuted the Enquiry, after the manner it is begun by the Author in his *Sylva Sylvarum*?

^s The Author has some useful Observations upon these Heads in the following Piece; but the Subject is by no means duly prosecuted.

^t See the Philosophical Transactions, Sir Kenelm Digby, Glauber, Mr. Boyle, Mr. Evelyn, and the later Writers upon Husbandry and Agriculture.

^u This must appear a strange Enquiry to the unphilosophical; and yet, whoever understands the Scope, Design, and Tendency, of the Author's History of Winds, will not judge it a Subject above the reach of the human Capacity.

^v That somewhat considerable may be done in this Way, appears from Mr. Boyle's Philosophical Enquiries; the Use of the Digestor; and many Pieces in the Philosophical Transactions, French Memoirs, &c.

^w As Nature does every Day in Vegetation, and Animalization. See Mr. Boyle's Philosophical Works.

23. *An Enquiry into the Methods of extracting new Foods, from Substances not now used for that purpose* ^a.
24. *An Enquiry into the Ways of making new kinds of Threads, Cloths, Stuffs, and Paper; for Apparel, Furniture, Hangings, &c.*
25. *An Enquiry into the Methods of improving the business of Natural Divination* ^b.
26. *An Enquiry after the Methods of deceiving, and imposing upon the Senses* ^c.
27. *An Enquiry into the best Ways of heightening the Pleasures of all the Senses* ^d.
28. *An Enquiry into the Ways of producing artificial Metals, Minerals, new kinds of Glafs, Pastes, and Cements* ^e. ^f.

^a This is an easy Enquiry, and open to every one's Diligence; yet who has treated it suitably to its Merit?

^b Some Attempts have occasionally been made in this Way; as by the hatchelling of Nettle-stalks, the weaving of Spiders Webs into a kind of Silk, the making of incombustible Paper from the Asbestus, &c. but the Enquiry is not, that I have met with, duly prosecuted.

^c So as, for example, to discover the Tempers and Thoughts of Men, from their external Appearances. This Enquiry also is not prosecuted and brought to certain Rules for Practice; at least, not in Europe.

^d See Morkof's Piece, *De Paradoxis Sensuum*; the *Recherche de la Verité*; and Mr. Berkley's Dialogues, &c.

^e The Author has hereafter many Observations to this purpose. The Enquiry seems not difficult; but Men are, generally, too much taken up with enjoying the common Pleasures of the Senses, to bestow time in considering how to heighten them, or discover new ones.

^f The Prosecution of this Subject has been generally left to mechanical Operators, and accidental Trial: but if Philosophers were to take it in hand, it seems capable of great Improvements. See Mr. Boyle, Becher, Kunckel, Homberg, Stahl, &c.

^g The Procedure of Dr. Childrey upon these Heads of Histories, is worthy of Imitation. In a Letter to Mr. Oldenburg, Secretary of the Royal Society, dated July 12, 1669. he writes thus: "I bought me as many Paper-Books, as my Lord Verulam has Histories at the end of his *Novum Organum*; in which I entered all the philosophical Matters, I met with, observable in my Reading; and intend to continue it." The same Gentleman, in the Year 1661. published a Book entitled *Britannia Baconica*; or, the Natural Rarities of England, Scotland, and Wales; historically related, according to the Precepts of the Lord Bacon. And this was followed by Dr. Plot's *Natural Histories of Oxfordshire and Staffordshire*. See Wood's *Athenæ Oxonienses*, Vol. II. Pag. 468. under the Article *Joshua Childrey*.

S T L V A

SYLVASTYLVARUM:

O R,

MEMOIRS for a GENERAL HISTORY

O F

NATURE and ART.

ACCELERATION.

*Acceleration a
capital En-
quiry.*

ACCCELERATION, is a capital Thing in the Works of Nature; and even, in divine Miracles, next to the creating of the Matter: whence all *Accelerations*, should be diligently enquired into^a. See the Articles BIRTH, GROWTH, CLARIFICATION, MATURATION, METALS, PUTREFACTION, and VEGETATION.

AFFECTIONS.

That the Spirits retire in Affections of the Body, illustrated in all the Senses. All very offensive Objects of the Senses, cause the *Spirits* to retire; and upon this Flight, the Parts are, in some degree, deserted; whence they fall into a Trepidation and Horror. In *Sounds*; the grating of a Saw, or any very harsh Noise, sets the Teeth on edge, and makes all the Body shiver. In

^a In all the Works of Nature and Art, nothing is more desirable and advantageous than Expedition, joined with Perfection. Hence, to produce Vegetables, to erect Buildings, cure Diseases, and execute, in every kind, quick and thoroughly, is the Perfection of Art. There are many Methods of Acceleration, which should severally be sought and described. Thus, for instance, one is by *dropping intermediate Operations*; as in the making of Vinegar, without *vinous Fermentation*, or the Delay of converting the Liquor first into Wine. This we find often done by accident, in *Brewing*; and might therefore be applied to shorten the common tedious Process of *Vinegar-making*. So likewise a Species of Wines may be expeditiously produced, without *Fermentation*; viz. by *Maceration* and *Mixture*. And thus may numerous *Arts* and *chemical Processes* be shortened, and rendered more advantageous, by dropping an intermediate Operation. And we cannot but wonder this Enquiry should have been so remissly carried on in particular Arts, that seem more capable of being accelerated; especially, as *Estates* might readily be raised, by making Commodities soon fit for the Market. The Business of *Acceleration* is therefore a capital Enquiry in *operative Philosophy*; and deserves to be prosecuted in all *Arts* and *Sciences*.

In *Tastes*; the taking of a Potion, or Pills, causes the Head and the Neck to shudder. In *Smells*; the like Effect follows, tho less perceived, because there is a Remedy at hand, by stopping the Nose: but, in Horses, that can use no such help, the Smell of Carrion, especially that of a dead Horse, makes them fly away, and start, as if they were mad. In *Feeling*; if a Person comes out of the Sun, suddenly into the Shade, there follows a Chilness, or small shivering over all the Body. And, even in the *Sight*, which has no odious Object, coming into sudden Darkness induces a kind of Shuddering ^b.

A I R.

1. Great Diligence is required in the Choice of certain Bodies and Places, *The Trials to as it were, for tasting and trying of Air; to discover the wholesomeness or unwholesomeness, both of the Seasons, and Seats for Habitation. There are some Houses wherein Sweet-meats, and Pies, will grow mouldy sooner than in others: and a Piece of raw Flesh or Fish, will sooner corrupt in some Airs than in others. They are noble Experiments that can assist in this Discovery; as affording a Natural Divination of Seasons better than those of Astronomers. And, again, they teach Men where to chuse their Dwelling, for Health^c.* *The Trials to be made of Air.*

2. 'Tis reported, That if Earth be taken up, adjoining to the River Nile, and preserved from wet and waste, it will not alter in weight till the 17th Day of June; which is the Day the River begins to rise: but then grows more and more ponderous, till the River comes to its height. This, if true, must be *caused* by the Air; which then begins to condense; and so turns in the Mould to a degree of Moisture, and produces weight. Tobacco cut, weigh'd, and dried by the Fire, loses weight; and being laid in the open Air, recovers it again. And it should seem, that as soon as the River begins to increase, the whole Body of the Air adjacent suffers a Change: for, 'tis affirmed, that upon the very Day the River first rises, great Plagues suddenly break out in Cairo ^d. *Whether Air may turn to Water.*

V O L. III.

F

3. Star-

^b 'Tis worth observing, how closely, and aphoristically, the Author traces Nature; and simply endeavours to express the naked Fact, or Phenomena; all along laying the Foundation for a just Interpretation. And let not the Use of the Word *Spirit* be here objected to, till a better can be substituted; or till the Enquiry into the Affections be thoroughly pursued. See the Author's Enquiry into *Life and Death*; and that about *Rarity and Density*, with regard to *Animal Spirits*. It might here be added, that some particular Notes in Musick, especially on the Organ, cause the Body to shudder visibly; and sometimes the Seats in the Churches to tremble: that *marial Musick* makes some turn pale, whilst it causes the Heart and Pulse to beat stronger, &c. But the Intention of our Notes is not to prosecute the Author's Design; only to give Intimations for farther Enquiry.

^c It seems strange, that this Enquiry should not have been farther prosecuted; especially, considering the Foundation laid for it in Mr. Boyle's *Memoirs for a general History of the Air*. One Reason may be, the little Knowledge Men generally have of *chemical Bodies*: a proper Set whereof might, perhaps, be contrived for discovering the more considerable *Ingredients of the Atmosphere*, in particular Countries and Places, with the same Certainty as we do those of *Mineral Waters*.

^d Mr. Boyle has several Considerations upon this Head: but perhaps the Fact itself is not sufficiently verified; and, till it be, it were improper to produce a number of similar Instances: which

*In what state
coldest.*

3. Star-light, and bright moon-shiny Nights, are colder than cloudy Nights : the *Cause* may be the dryness and thinness of the Air, which thereby becomes more piercing and sharp. For large Continents are colder than Islands. And tho the Moon may incline the Air to Moisture ; yet when it shines bright, it argues the Air to be dry. Close Air is also warmer than open Air : for the *cause of Cold*, is, perhaps, an *expiration from the Earth*, which in open places is stronger ; and Air, itself, if unaltered by that Expiration, is not without some secret degree of Heat ; as 'tis not without some secret degree of Light : otherwise Cats and Owls could not see in the Night ; but the Air then hath a little Light, proportionable to the visual *Spirits* and *Organs* of those Creatures *c*.

*Whether Air
may be con-
densed for
Nourishment.*

4. *Onions* will often shoot as they hang in a Room ; so will *Orpin*, and the greater *House-leek*, for two or three Years together ; if the Root be wrapt in a Cloth besmeared with Oil, once in half a Year : and the like is reported of the Stalks of Lillies. These Plants seem to have a strong, dense and succulent Moisture, not apt to exhale ; and is thence capable of supplying the Sprout from the old Store, without the help of the Earth : and this sprouting is chiefly found in the late Spring, or early Summer ; which are the times of putting forth. We see also, that Stumps of Trees, lying out of the Ground, will sprout for a Season. But it is a noble Experiment, and of great Consequence, to find whether these Bodies gain weight in sprouting. For if not, then what they send out in the Sprout, they lose in some other part ; but if they increase in weight, then it shews that *the Air may be so condensed, as to become a dense Body* *f* : whereas the general Course and Period of Things, here above the Earth's Surface, is to rarify, and not condense. This wou'd also shew, that the Air may nourish ; which is another matter of Consequence. Note, that to try this, the Experiment of the House-leek shou'd be made without oiling the Cloth ; otherwise the Plant might receive Nourishment from the Oil *g*.

A L T E R A-

which kind of Procedure is apt to make Facts pass for Truths, without being carefully examined. See *Prosper Alpinus*, *Johan Varot*, &c. and compare them with Mr. Boyle's *Memoirs for a general History of the Air*.

c What is the adequate Measure of Cold ? The direct Senses only determine of Cold and Heat for themselves. Is the Fact strictly and universally true ; that bright Nights are colder than Cloudy ones ? There sometimes happen very sharp misty Nights. Is the cause of Cold covered ? What Judgment can safely be form'd of the modern Mechanical Doctrine of Cold and Frost ? With what degree of certainty is *Rarefaction* made the Measure of Heat ? How far can the Informations of the Thermometer be safely trusted ? Are Thermometers arrived at their Perfection ? How does the Moon incline the Air to Moisture ? Has Air any Light from within itself ; not owing to the Sun and Stars ? These particulars should be farther enquired into. See the Article COOLNESS, in this Piece : See also the History of Winds, and Mr. Boyle's *Experimental History of Cold*.

f A comparison of this with Mr. Hales's *Vegetable Staticks*, may give us some Notion of the Author's Sagacity, and Foresight into the Issues and Consequences of Experiments unmade in his own Time.

g This is a capital Enquiry, and has been prosecuted by Mr. Boyle, and many of the Members of the Royal Society, the *French Academy*, and more particularly of late by Mr. Hales ; so far as to shew that Air may be fixed, and condensed into a solid nutrimental Substance. And may not then this Discovery admit of some very useful Applications, and farther Improvements ?

A L T E R A T I O N S.

1. There are many *great Alterations of Bodies*, besides those that tend to *Great Alterations of Bodies, what, Concoction and Maturation*: for whatever so alters a Body, that it returns no more to what it was, may be call'd a *great Alteration*; as when *Meat* is *boil'd, roasted, fry'd*; *Bread* baked; *Cheese* made; *Charcoal* prepared^b, &c. But to apply *Philosophical Notions* to *vulgar Terms*; or to say, where these Notions cannot be aptly reconcil'd, that there wants a Term for it, is but the *Shift of Ignorance*: for Knowledge will always remain a wandering and indigested Thing, if it be no more than a mixture of a few obvious Notions, and not built upon a *sufficient number of Instances*, well compared together¹.

2. The Consistences of Bodies are very various; dense, rare; tangible, pneumatical; volatile, fix'd; determinate, indeterminate; hard, soft; cleaving, not cleaving; congealable, uncongealable; liquefiable, not liquefiable; fragile, tough; flexible, inflexible; tractile, intractile; porous, solid; equal and smooth; unequal, veiny and fibrous; with a grain; entire, &c. to refer all which to Heat, Cold, Moisture, and Drought, is a fruitless *Speculation*.

A N I M A L S.

1. The difference between *Male* and *Female*, in some Creatures, is not *The difference to be seen but in the parts of Generation*: as in Horses, Dogs, Doves, &c. *in Male and Female Ani- mals.* But some Species of Creatures differ in Magnitude, and that variously; in most the Male is the greater; as in Man, Pheasants, Peacocks, Turkeys, &c. but in some few, as Hawks, &c. the Female is the largest. Some differ in the Hair and Feathers, as to Quantity, Curl and Colour; thus *He-Lions* are Shaggy, and have large Mains; but the *She-Lions* are smooth like Cats. Bulls are crisper upon the Forehead than Cows. The Peacock, Pheasant-cock, and Goldfinch-cock, have fine Colours; but the *Hens* not: and generally the Cock-birds have the fairest Feathers. Some differ in particular Parts; as Bucks have Horns, Does none; Rams have Horns more wreath'd than Ewes; Cocks have large Combs and Spurs, Hens little or none; Boars have great Fangs; Sows much less; the Turkey-cock hath large swelling Gills, the Hen hath less; Men have generally deeper and stronger Voices

F 2

than

^b Are not these *great Alterations* of Bodies a kind of *Transmutations*? They have this Characteristick of Transmutations, that they are inconvertible, by any Art hitherto known, into the same Bodies again. To speak the Truth; Men appear to have perplexed themselves about the Terms *Alterations* and *Transmutations*; and imagined I know not what Mysteries, and Impossibilities in them: whereas in the Judgment of the Senses; and even of an exact and thorough Scrutiny, many *natural* and *artificial Operations* are *Transmutations*; whatever difficulty there may be in conceiving the *Modus* of the Thing. And if this imaginary Difficulty were once got over, I am persuaded many considerable Discoveries of Changes and Alterations in Bodies would be made publick; which are now concealed for fear of popular Odium, and Censure. See the *Articles, CONCOCTION, GOLD, and TRANSMUTATION.*

¹ See this prosecuted in the *Novum Organum*; passim.

than Women. Some differ in Faculty ; as the Cocks among Singing-Birds are the best Singers.

Its Cause.

2. The chief *Cause* of all this, shou'd seem that the Males have more Heat and Strength than the Females ; as appears from hence, that all young Male-creatures are like Females : and so are Eunuchs, and castrated Creatures of all kinds. Now Heat generally causes largeness of Growth, where there is Moisture enough to work upon : but if any Creature has too much Heat in proportion to its Moisture, there the Female is the larger ; as in Hawks and Sparrows. And if the Heat be ballanced with the Moisture, there is little difference to be seen between Male and Female ; as in Horses and Dogs. We see also, that the Horns of Oxen and Cows are usually longer than of Bulls ; which is caused by an abundance of Moisture, in the former, and wanting in the Horns of the Bull. Again, Heat causeth Pilosity and Crispation ; and so likewise, Beards in Men. It also expels the finer Moisture ; which want of Heat cannot do ; and hence the Beauty and Variety of Feathers in the Male Birds. Heat also causes many Excrecences, and much solid matter ; which want of Heat cannot do : and this is the cause of Horns, and their largeness ; as likewise of the Combs and Spurs of Cocks, Gills of Turkey-Cocks, and Fangs of Boars. Again, Heat rarifies and dilates the Pipes and Organs of the Body, whence the deepness of the Voice in Men. And thus Heat may refine the Spirits, and cause the Cock-singing-Bird to excel the Hen ^k.

Of the comparative magnitude of living Creatures.

3. There are *Fishes* larger than any *Beasts* ; as the *Whale* is much larger than the *Elephant* : and *Beasts* are generally larger than *Birds*. *Fishes* living not in the Air, have not their Moisture drawn and drained by the Sun : besides, they in a manner rest continually, and are supported by the Water ; whereas *Beasts* consume with Motion and Labour. *Beasts* are larger than *Birds* ; perhaps because they continue longer in the Womb than *Birds*, and there nourish and grow ; whereas *Birds*, after the Egg is laid, receive no further Growth or Nourishment from the Female : for the sitting does but vivify, not nourish ^l.

A N N I H I -

^k The Reader will all along observe, that the Author only makes Attempts for discovering the Causes of Things ; and does not pretend to have found them. The *Discovery of Causes* is a particular Work ; that was to be prosecuted by numerous, exact, and rigorous Enquiries, in the fourth Part of the *INSTAURATION*, according to the inductive Method laid down in the *Novum Organum*. The present Collection therefore of *Differences betwixt Male and Female Creatures*, is to be farther enlarged, examined, and proved ; whether they proceed from *Heat*, or a certain original subtle difference in the Conformation of the Parts ; or both, or any other auxiliary and concurrent Causes. See *Memoires de l'Academie Royale pour servir a l'Histoire des Animaux*.

^l These shou'd be construed noble Attempts towards laying a Foundation for the *physical Reasons* of Things ; tho, upon fuller Information, they were to be found erroneous, or not strictly true. If the Reader has diligently perused the *de Augmentis Scientiarum*, & *Novum Organum*, he will have no farther occasion to be told how the *Sylva Sylvarum* is to be understood ; the purposes it was intended to answer ; the uses to be made of it ; and the many improvements it must necessarily require.

ANNIHILATION.

'Tis certain, that Matter cannot be annihilated: for as it was the Work of Omnipotence to make somewhat out of nothing; so it requires the like Omnipotency to turn somewhat into nothing. It was therefore well said by an obscure Chemist; that *there is no surer way of working strange Transmutations in Bodies, than by strenuously endeavouring to reduce Bodies to nothing.* And herein is contained a great Secret, as to the Preservation of Bodies; for if we can keep them from turning into Air, by excluding the Air from them; from going into the Bodies adjacent, by chusing those utterly heterogeneal; and lastly from having any Circulation within themselves; they can never change; tho' in their Nature ever so perishable. We see, how Flies, Spiders, &c. acquire a Sepulchre in Amber, more durable than the Monuments and Embalmings of Kings. And I suspect the like of certain Bodies put into Quick-silver. But then they must be thin; as a Leaf, a piece of Paper or Parchment: for if they have a greater Thickness, they will alter within themselves, tho' they waste notⁿ. See the Article PRESERVATION.

A T T R A C T I O N.

1. The Turkish Bow shoots so forcibly, that an Arrow from it has pierced a Steel Target, or piece of Brass, two Inches thick: but what is more strange, the Arrow, tho' headed with Wood, hath gone thro' a piece of Wood, eight Inches thick. And 'tis certain we formerly used in Sea-fight, certain short Arrows, which they call'd *Sprights*, without any other Head, than Wood, sharpened; and these discharged out of Muskets, would go thro' the sides of Ships, where a Bullet would not enter. *This depends upon one of the greatest Secrets in Nature; viz. that SIMILITUDE OF SUBSTANCE WILL CAUSE ATTRACTION, where the Body is wholly freed from the Motion of Gravity:* for if that were away, Lead wou'd attract Lead, and Gold attract Gold, and Iron attract Iron, without the help of the Loadstone. But this same Motion of Gravity, being a mere Motion of the Matter, and having no affinity with the Form, or Kind, destroys the other Motion; except itself be destroy'd by a violent Motion, as in these Instances of Arrows; for then the Motion of Attraction by Similitude of Substance begins to shew itselfⁿ.

2. 'Tis

ⁿ There is somewhat of Moment couched in this Paragraph; especially with regard to the Nature of Corruption, or Putrefaction. Nor is the Subject, tho' it has passed thro' many Hands, well prosecuted. To acquire a Command over Putrefaction, in natural Bodies, wou'd be acquiring a capital Command: and yet the Foundation of the Enquiry is laid here.

ⁿ Is the Fact here delivered, well verified, and absolutely ascertained? It is a thing of that importance to Physicks, as to require the strictest Examination: and perhaps the whole of Chemistry depends upon this Doctrine of Similitude; where *Simile Simili gaudet* may pass for an Axiom, deduced from numerous Experiments; and so well verified, as possibly to deserve a place in the *Philosophia Secunda*, or sixth Part of the Author's INSTAURATION. Sir Isaac Newton's whole System of Physicks rests upon the Principle of Attraction. See the Note upon the Article GLASS.

In Salt-Water. 2. 'Tis said, That *salt Water* will dissolve *Salt* sooner than fresh. The Cause may be ; that the Salt in the Water, by Similitude of Substance attracts the Salt new put in ; whereby it diffuses in the Liquor more speedily. This is a noble Experiment, *if true* ; for it shews a Means of making more quick and easy Infusions : and is likewise, a good Instance of *Attraction*, by *Similitude of Substance*. Try it with Sugar put into Water formerly sugared, and in other Water unsugared^o.

*Attraction in
Sugar and
Wine.*

3. Put a Lump of Sugar to Wine, part above, and part under the Surface ; and the Sugar above the Wine will soften and dissolve sooner than that within it^p : the Wine entering the under part of the Sugar, by simple Infusion, or spreading ; whilst the upper part is likewise affected by *Suction*^q. For all spongy Bodies expel Air, and attract Liquor, if it be contiguous : as we see in a Sponge, with one part dipt in Water. 'Tis worth enquiring, how to make more accurate Infusions by help of Attraction^r. See the *Articles* ELECTRICITY, MAGNETISM, and SYMPATHY.

B.

B A T H I N G.

*The Use of
Bathing and
Anointing.*

'TIS strange that the Use of Bathing is dropt : with the *Romans* and the *Grecians* it was as usual as eating or sleeping ; so 'tis among the *Turks* at this day ; whilst, with us, it remains but as a part of Medicine. I guess, the Use of it among the *Romans* was found hurtful ; as, making the Body soft, and easy to waste. For the *Turks* 'tis more proper, *because* their drinking Water, and feeding upon Rice, and other Food of little Nourishment,

^o Tho an Experiment may be ever so easily made, yet, thro' a strange Indolence, the Generality had rather believe or disbelieve it, upon hearing, than rise and try it. And till this indolent Temper be conquered, no wonder if *Experimental Philosophy* languish ; and our common Discourses, and Books, continue full of nauseous Repetitions of Facts, handed down from Age to Age unverified. Let this Experiment therefore be tried with care, by adding only a small Proportion of Salt or Sugar to the Water at first ; for every one knows, that when a Liquor is fully saturated with a Substance ; it will dissolve no more of that Substance, tho it may of another. There are some Experiments to this purpose in the *Philosophical Transactions* and *French Memoirs*.

^p This Experiment is easily tried.

^q What was formerly attributed to Suction, is now, in great measure, found owing to Impulse, or the Pressure of the Air : and for that kind of Suction which happens in slender Glass Tubes plunged in Water, as well in *Vacuo* as in the open Air, 'tis now called by the Name of *Attraction* ; with little difference as to the *Phenomenon*, or its Cause.

^r What does the Author mean by making more accurate Infusions by the help of Attraction ? Perhaps he had a View to that Way which the Chemists call *per Deliquium* ; where a Salt, or other Body, attracts the Moisture of the Air, and runs into a Liquor with it. And this, in many cases, is a better Method than that by dissolving the Body in common Water. Thus Sugar, Salt of Tartar, &c. will relent and run by the moisture of the Air, or by being suspended over Water, &c. by which they imbibe the lighter and more subtle Particles of the Fluid : and if the brisk and sprightly *Mineral Waters* contain any material, liquid Spirit ; whereto their Virtue is owing ; were not this a proper Expedient or Encheiresis for catching and detaining it, in a neutral Substance, as it naturally flies off at the Spring-head, or from the containing Vessel ?

ment, makes their Bodies so solid and hard, that Bathing cannot well soften them too much. Besides, the *Turks* are great Sitters, and seldom walk ; whence they sweat less, and need bathing more : yet, Bathing, and especially Anointing, may be so used as greatly to promote Health, and long Life^a. See the *Article* SWEAT.

BIRTH.

The Births of living Creatures may be *accelerated* in two respects: the one, if the *Embryo* ripen and come to perfection sooner ; the other, if there be some CAUSES of Expulsion from the Mother's Body : the former is good, and argues Strength ; but the latter bad, and proceeds by Accident, or Disorder. Whence the antient Observation is true, that *a Child born in the seventh Month commonly does well ; but born in the eighth Month generally dies*. For where there is so great an Anticipation of the ordinary Time, this seems owing to the strength of the Child ; but when the Anticipation is less, to some Indisposition of the Mother^b.

The Means of accelerating Births.

BLACK-MOORS.

The heat of the Sun may make Men black in some Countries ; as in *Æthiopia, Guinea, &c.* Fire has not the same Effect ; as we see in *Glass-Men*, who are continually about the Fire. Perhaps, Fire licks up and exhales the Spirits and Blood of the Body ; whence it always makes Men look pale and fallow ; whilst the Sun, which is a gentle Heat, only draws the Blood to the outward Parts ; and rather concocts than drinks it up : whence all *Æthiops* are fleshy, plump, and large lipped : which shews Moisture retained, and not exhaled. We see also, that the *Negroes* are bred in Countries abounding with Water, by means of Rivers, or otherwise : for *Meroe*, the Metropolis of *Æthiopia*, stood upon a great Lake ; and *Congo*, where the *Negroes* are, is full of Rivers ; the Confines of the River *Niger*, where *Negroes* also abound, are well watered ; and the Region of *Cape Verde* is pestilent, thro' Moisture : but the Countries of the *Abyssines, Barbary, and Peru*, where the Natives are tawny, olive-coloured, and pale, prove generally more sandy and dry. And the *Æthiopians*, perhaps, are sanguine and ruddy, if their *black Skins* would suffer it to be seen^c.

The Colour of Black and Tawny Moors.

BLOOD.

^a Some Attempts have of late been made to revive the ancient Practice of Bathing, tho rather the *cold* than the *warm* and temperate kind. See Sir *John Floyer*, and Dr. *Baynard* on the Subject. There can be little question made of the Usefulness of both kinds, when properly employ'd : but the Rules for applying them are not well deduced, and established. Dr. *Hoffman* has set an Example for regulating the use of warm Bathing : see his *Pieces upon Mineral Waters*. But for the Subject of *Anointing*, it seems in a manner neglected ; tho capable of great Improvement : as may, in some measure, appear by the Author's *History of Life and Death*.

^b This Paragraph may serve to direct the Enquiry into the proper Methods of hastening Delivery.

^c This short Collection of Observations contains the Foundations of a noble Enquiry ; the Cause of Blackness in the *Moors* : and leads directly up to the Discovery, that this Blackness is seated in the *Reticulum Musosum*. See *Malpighi, Ruysch*, and the modern *Anatomists*.

BLOOD.

The Blood of the Cuttle-Fish black.

'Tis strange, that the Blood of all Birds, Beasts, and Fishes, should be of a red Colour; and only the Blood of the *Cuttle* black, as Ink. One would think, this *proceeded* from the high *Concoction* of the Blood; for, we see, in the common Black-puddings, that boiling turns the Blood of them black: and the *Cuttle-Fish* is accounted fine eating^d.

BONES and TEETH.

Memoirs for the Enquiry of restoring Teeth in old Age.

1. To restore the Teeth in old Age were a capital Work. There are five kinds of hard Substances in animal Bodies; viz. (1.) Skull, (2.) Teeth, (3.) Bones, (4.) Horns, and, (5.) Nails. The greatest Quantity of hard Substance, is seated towards the Head; for there are the Skull, the Teeth, the maxillary Bones, the *Offa Petrosa*, and the Horns; so that the Structure of animal Bodies, is like that of a House; where the Walls, and other parts, have their Columns and Rafters; but the Roof is of Tile,

Observations.

(1.)
That bony Matter is plentifully supplied to the Head.

Lead, or Stone. *Birds* have three other hard Substances; viz. (1.) the Bill, of like matter with the Teeth, for no *Birds* have Teeth. (2.) The Shell of the Egg. And, (3.) Quills: their *Spurs* being but as a Nail. No living Creatures that have hard Shells; as Oysters, Cockles, Muscles, the *Tortoise*, &c. have Bones within them, only small Gristles^e.

(2.)
That Bones, at their Growth, do not waste.

2. *Bones*, after full Growth, continue at a stay; so does the Skull: but Horns, in some Creatures, are cast and renewed. The *Teeth* stand at a stay, except their wearing: *Nails* grow continually; and *Bills* and *Beaks* will overgrow, and sometimes be cast; as in *Eagles* and *Parrots*.

(3.)
That bony Matter naturally goes to the Extremities.

3. Most hard Substances go to the Extremities of the Body; as the Skull, Horns, Teeth, Nails, and Beaks: only the Bones are more inward, and clad with Flesh. The Entrails are all without Bones, except that a Bone is sometimes found in the Heart of a Stag; and, perhaps, some other Creatures^f.

(4.)
The Contents of the Bones.

4. The Skull contains the Brain, as a kind of Marrow. The *Back-bone* holds a kind of Marrow, having an Affinity with the Brain; and the other Bones hold another kind. The *Jaw-bones* have no Marrow separated, but a little pulpy Matter diffused in them. The *Teeth*, likewise, are said to have a kind of *diffused Marrow*, which causes the Sense and Pain of the Part; but 'tis rather a *Nerve*: for Marrow has no more Sense than Blood^g. *Horn* is alike throughout, and so are the *Nails*.

(5.)
The Teeth have Sensation.

5. None of the hard Substances have Sense^h but the *Teeth*; and these have Sense not only of Pain but of Coldⁱ. The Teeth, in Men, are of three kinds;

^d Is the black Juice of the *Cuttle-Fish*, the proper Blood of the Creature? Consult the Naturalists.

^e We have here a little Model of a *Natural Enquiry*, conducted in the regular Way, so as to exhibit a short View, and Example, of the inductive *Method* laid down in the *Novum Organum*.

^f Consult the Naturalists; or, rather, Nature herself.

^g 'Tis esteemed a modern Discovery, that the Marrow and Bones have no Sensation.

ⁱ Viz. By means of the Nerves that line their Cavities.

kinds ; viz. (1.) Sharp, as the Fore-teeth ; (2.) Broad, as the Back-teeth ; which we call Ginders ; and, (3.) Pointed, or *canine* ; which are between both. But some have had their Teeth undivided ; and consisting of one whole Bone, with a little Mark in the place of the Division ; as *Pyrrhus* had. (6.)
The Teeth in Men of three kinds.

6. Some Creatures have over-long, out growing Teeth, call'd Fangs, or Tusks ; as Boars, Pikes, Salmons, and Dogs. Some Creatures have Teeth against Teeth ; as Men, and Horses : and some have Teeth, especially their Master-teeth, indented one within another, like Saws ; as Lions, and Dogs. Some Fishes have divers Rows of Teeth in the Roofs of their Mouths ; as Pikes, Salmons, Trouts, &c. and many more in salt Waters. *Vipers*, and other Serpents, have venomous Teeth ; which are sometimes mistaken for their Sting ^k. (7.)
Some Creatures have out-growing Teeth.

7. No horned Beast has upper Teeth ^l ; and no Beast that has Teeth above wants them below : but tho the hard Matter be of the same kind, it is no consequence, that because this bony Matter does not go into upper Teeth, it must needs go into Horns ; nor, *vice versa* : for Does, that want Horns, have no upper Teeth ^m. (8.)
No horned Beast has upper Fore-teeth.

8. Horses, at three Years old, have a Tooth, which they call the *Colt's Tooth* ; and, at four Years old, there comes the *Mark Tooth* ; which has a Hole big enough to receive a Pea : and this Tooth wears shorter and shorter every Year ; till, at eight Years old, the Tooth is smooth, and the Hole worn out ; and then, they say, *the Mark is out of the Horse's Mouth* ⁿ. (9.)
The Mark in Horses Teeth.

9. The Teeth, in Man, first breed at a year and half from the Birth ; they are afterwards cast, and new ones come about seven ^o : but many have the Hind-teeth grow at twenty, and some at thirty or forty Years old. *Quære*, the manner of their coming ^p. They say of the old Countess of *Desmond*, who lived to seven Score, that she bred her Teeth twice or thrice ; casting her old ones, and others coming in their place. (10.)
The shedding and new growing of the Teeth.

10. The Teeth are much damaged by Sweet meats ^q ; painting with Mercury ; by things over-hot, or over-cold ; and by Rheums. And the Tooth-ach is one of the sharpest of Pains. (11.)
How the Teeth are damaged.

11. The following Particulars should be considered ; viz. (1.) The Means of preserving the Teeth. (2.) The Ways of keeping of them White. (12.)
Particular Enquiries about the Teeth.

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(3.) The

^k It has been discovered, that the Teeth in *Vipers*, is not the seat of the Venom ; but a particular Bag, that lies underneath the Tooth, in the Gum. See *Dr. Mead's Essays on Poisons*.

^l This must, I suppose, be meant of Fore-teeth only ; for, even *Calves*, have upper Hind-teeth.

^m Viz. Fore-teeth.

ⁿ See *Mr. Chambers's Dictionary*, under the Article *Horse*.

^o Do Children always cast their Teeth ? and, do the Teeth often grow even and regular, after once shedding ?

^p It seems to be usually attended with some degree of Pain, Swelling, and Inflammation of the Gum : whilst the Tooth, being large and broad, makes its way slowly ; so as to be several Months, or perhaps Years, in cutting, and coming to a level with those in the same Jaw.

^q This is denied by some with regard to *Sugar* ; tho they allow it true of *unwashed Raisins*. *Sugar* is extremely penetrating in some cases ; but how stands the Fact, in respect of the Teeth ?

(3.) The Ways of drawing of them with least Pain. (4.) The Cure of the Tooth-ach. (5.) The Ways of fixing in artificial Teeth. (6.) And lastly, The Ways of restoring Teeth in Old Age.

(13.) 12. The Instances that render the last Attempt probable, are, (1.) The late coming of the Teeth in some Persons: (2.) The renewal of the Beaks in Birds, and Horns in Beasts. Let trial therefore be made, *whether Horns may be procured in Beasts that are not horned; and how?* And whether the Head of a Deer, that by Age is more *spitted*, may be brought again to be more *branched*. For these Experiments, and the like, will shew, whether the Growth of such hard Matter can be provoked by Art? It should also be tried, whether Birds might not be made to have greater or longer Bills, or greater and longer Talons; by doing something to them when young? And, whether Children may not have some Wash, or the like, to make their Teeth grow better and stronger? Coral is used as a help to the Teeth of Children^f.

BUBBLES.

Of Bubbles,
and the Cause
of the Sphericity of Liquors.

Bubbles are *Air* within, and a fine Skin of *Water* without: where it seems somewhat strange, that the Air should rise so swiftly, while it is in the body of the Water; and when it comes to the top, be staid by so weak a Cover. But the swift ascent of the Air, while under Water, is owing to a *Motion of Percussion* from the Water; whilst itself descending, drives up the Air; and not to a *Motion of Levity* in the Air. In this common Experiment of producing Bubbles in Water; the Sphericity and Enclosure of the Bubble proceeds from the *Appetite of resisting Separation*, which Fluids have; tho in a less degree than Solids. This is also manifest in the little Looking-glasses, which Children make with Rushes and Spittle; and in the Castles of Bubbles, which they make by blowing into soapy Water^e. We see it also in the Drippings of Spouts; which, if there be Water enough to follow, will draw themselves into a small thread, rather than discontinue; but if there be no other way left, they cast themselves into Rounds; which is the Figure that saves the Body most from Discontinuance: Whence also proceeds the Roundness of Bubbles, as well with regard to the Skin of Water, as the Air within; since the Air likewise, to avoid Discontinuance, throws itself into a round Figure.

^e In order to this, let a previous Enquiry be made into the Nature of that the Chirurgeons call a *Callus*; which seems to proceed from a fluid Substance, ouzing thro' the Pores of a Bone, and concreting extremely hard upon the broken Part; so as to become a Cement, and add to the bony Matter, whereof the Part before consisted. This might easily be transferred, and practised upon the Skulls of hornless Animals; to try, if an artificial kind of Horns could not be thus procured. But I am sensible the proposing of such Experiments looks ridiculous to many; who, however, are willing to admit them, when fully verified.

^f This Enquiry has, by no means, been duly prosecuted. Physicians and Chirurgeons seem to think it below their notice; and most Philosophers are otherwise engaged. Tho, perhaps, they might deserve as well of Mankind, by discovering particular Methods of making Life more easy, as by ranging the wider Fields of Science.

^g The Author has several times apologized for, and shewn the Necessity of, observing the meanest and commonest Experiments, in order to a *History of Nature and Art*.

Figure. And, for the small Stop of the Air, before the Bubble bursts; it shews, that Air, of itself, has no great Appetite of ascending ^u.

B U R I A L S.

1. *Burials* in Earth, serve for the *Preservation*, *Condensation*, and *Induration* of Bodies. If *Condensation*, or *Induration*, be intended; the Bodies may be buried so as for the Earth to touch them; as in making artificial Porcellane ^v, &c. And the like may be done for *Conservation*, if the Bodies are hard and solid; as Clay, Wood, &c. But if the Design be the *Preservation* of soft and tender Bodies; we must either put them in Cases, so that they may not touch the Earth, or else vault the Earth, so that it may hang over them; for if the Earth touch them, it will do more hurt by its putrefying Moisture, than good by its virtual Cold; unless the Earth be very dry and sandy.

Of burying Bodies in Earth.

2. An *Orange*, a *Lemon*, and an *Apple*, wrapt in a Linen Cloth, being buried for a Fortnight, four Foot deep in the Earth of a moist Place, and in a rainy Season, came out no ways mouldy or rotten; but a little harder than they were, and otherwise fresh in their Colour; tho their Juice was somewhat flatted. But, by being buried for a Fortnight longer, they became putrefied.

Experiments on Fruits, by burying.

3. A Bottle of Beer, and another of *Wine*, buried in like manner, became more lively, better tasted, and clearer. A Bottle of *Vinegar*, so buried, came out more lively, more odoriferous, and smelling almost like a Violet. And, after a Month, all the three came out as fresh and lively, if not better than at first.

On Liquors.

4. It might be a profitable Experiment, to preserve *Oranges*, *Lemons*, and *Pomegranates*, till Summer; for their Price would then be greater. This might be done by putting them in a Pot, or Vessel, well covered, that the moisture of the Earth come not at them: or else by putting them in a Conservatory of Snow ^w. And, in general, whoever would make *Experiments with Cold*, should be provided of a *Conservatory of Snow*; a large Vault, at least twenty Foot under Ground; and a deep Well ^x.

Requisites to the making Experiments by Cold.

5. *There is a Tradition*, that *Pearls*, *Corals*, and *Turcois-stones*, which have lost their Colour, may have it recovered, by burying them in the Earth; which is a thing of great Profit, *if true*: but upon trial of six Weeks, there followed no Effect ^y. It were proper to try it in a deep Well, or in a Con-

Experiments of burying precious Stones, to recover their Lustre.

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servatory

^u This Subject has been re-considered by Mr. Boyle, Sir Isaac Newton, and many more; tho, perhaps, without being carried much farther than it is here by the Author.

^v Do they actually bury their Earth in *China*, for making their Porcellane? or, Is there any Necessity for burying it? Would not the bare *Trituration*, and *Washing* of a proper terrestrial Matter suffice?

^w But the Fruit must not be suffered to freeze: for that would spoil them, without a particular Remedy; as by thawing them in cold Water.

^x See the Author's *New Atlantis*, and Mr. Boyle's *History of Cold*.

^y It is a serviceable and just Observation, that Experiments which fail of the End proposed in making them, are no less *instructive* than those that succeed.

servatory of Snow, where the Cold may be more constringent ; so as to make the Bodies more compact, and resplendent ^z.

C.

CANTHARIDES.

Whence Cantharides become corrosive.

C*antharides* are bred from a Worm, or Caterpillar, peculiar to certain Fruit-trees ; as the Fig, the Pine, and the wild Briar ; which bear sweet Fruit, having a kind of secret Pungency, or biting Sharpness : for the Fig-tree abounds with a sweet and corrosive Milk ; the Pine-apple has a Kernel that is pungent and absterfive ; and the Fruit of the Briar being eaten, is said to make Children scabby ^a. No wonder, therefore, if Cantharides have a corrosive Quality ; for all other Insects are bred from a duller Matter. The Body of the *Cantharis* is bright coloured ; and, perhaps, the delicate coloured Dragon-fly may have some corrosive Quality ^b.

CATERPILLARS.

The breeding of Caterpillars.

Caterpillars are one of the commonest Worms, that feed on Dew and Leaves : we see infinite Numbers of them bred and nourished upon Trees and Hedges ; whereby the Leaves, are in great measure, consumed. They breed chiefly in the Spring ; because then there is both Dew and Leaf : and commonly when the East-winds have blown much ; on account of the Dryness of that Wind. For to all *Vivification upon Putrefaction*, 'tis requisite the Matter be not too moist : and therefore they have Cobwebs about them ; which is a Sign of a *slimy Dryness*. Green Caterpillars breed in the inward Parts of unblown Roses, where the Dew sticks : but the largest Caterpillars, and the greatest Numbers, breed upon Cabbages ; which have a fat Leaf, that is apt to putrefy. The *Caterpillar*, towards the end of Summer, turns to a *Butterfly* ; or, perhaps, some other Fly. There is a *Caterpillar* that has a Fur or Down upon it, and seems to resemble the Silkworm ^c. See the *Articles* GENERATION and INSECTS. C A

^z This Enquiry of Burials seems to have been much neglected ; particularly deep Burials, which might be properly recommended to Miners ; and prosecuted in *Fermentations, Putrefactions, Digestions*, and certain other chemical Operations. The Advantages of Vaults, in comparison of Cellars, are reckoned very considerable, with regard to fermented Liquors : What therefore would be the Consequence of having deeper Vaults ? The Air of different Places on the Surface of the Earth, produces different Effects in certain Cases ; as in Brewing, Dying, &c. How, therefore, would the same Operations be affected, or altered, in different Mines, abounding with different *Effluvia*, besides Air of different Densities ?

^a The Fact is, perhaps, not verified. And allowing that Scabbiness ensued upon eating of Blackberries ; let it be enquired, whether this proceed from eating the Fruit ? or, from the little Insects that usually swarm upon the Berries ? and may possibly stick to the Skin of such as handle them.

^b How far the Food of a Creature may remain unaltered, or pass unchanged into the Body of the Creature, is not hitherto ascertained. The Enquiry is noble, and useful : but whoever would succeed in it, must, perhaps, have more than a bare mathematical and mechanical Knowledge ; at least, he should also take into consideration, the *Doctrine of Menstruums*, or *Solvents* : for Liquors, capable of dissolving and transmuting some things more than others, appear to abound in all animal Bodies.

^c The *Natural History* of the Caterpillar, may have been well prosecuted, as to the Changes and different Phenomena of the Creature ; from the Egg, or *Aurelia* to its perfect State : but its

CATHARTICKS.

1. The *Operation of Purgatives*, and the *Causes* thereof, have been thought a great Secret ; and, according to the slothful manner of Men, referr'd to a hidden Property, a specifick Virtue, and the like Shifts of Ignorance. The *Causes* of purging are several ; all plain, and well supported by Experience*. The *first* is, that whatever cannot be overcome and digested, the Stomach either throws up by Vomit, or transmits to the Intestines ; and by this Motion of Expulsion in the Stomach and Guts, other parts of the Body are moved to expel by consent ; for nothing is more frequent than *Motion of Consent* in the human Body*. This Surcharge of the Stomach is caused, either by the *Quality* of the Medicine ; or by its *Quantity*. The *Qualities* are three ; viz. (1.) Extreme *Bitterness* ; as in Aloes, Coloquintida, &c. (2.) *Loathsomeness*, and a horrible Taste ; as in Agaric, black Hellebore, &c. And, (3.) A secret *Malignity*, that often does not appear much in Taste ; as in Scammony, Mechoacan, Antimony, &c. And observe, if any purging Medicine hath neither of the two first manifest *Qualities*, it is to be suspected a kind of Poison ; as working either by Corrosion, or by a secret Malignity, and Enmity to Nature : whence such Medicines are warily to be prepared, and prescribed. The *Quantity* of what is taken down, also causes *Purging* ; as a great Quantity of new Milk from the Cow ; and a great Quantity of Meat : for Surfeits often turn to Purgings, both upwards and downwards. Hence Purges generally operate two or three Hours after they are in the Stomach ; which first makes trial, whether it can concoct them. And the like happens after Surfeits ; or Milk taken in too great plenty.

(1.)
The Foundation of the Enquiry into the Nature and Operation of Purgatives.

The first Cause of purging is indigestibility.

2. A second Cause is *Vellication* of the Orifices of the Parts, especially of the Mesenteriac Veins. Thus *Salt*, or any such thing, that is sharp and biting, applied to the *Anus*, provokes the Part to expel ; as the Smell of Mustard provokes Sneezing ; and any sharp thing to the Eyes, provokes Tears. So that all Catharticks have a kind of twitching and biting ; besides the griping which proceeds from Wind. And if this Vellication be in a violent degree, it proves little other than *Corrosion*, or *Poison* ; as sometimes happens in *Antimony* ; especially if it be given to Bodies not replete with Humours : for, where Humours abound, these guard and defend the Parts.

(2.)
Vellication.

3. The third Cause is *Attraction* : for purging Medicines have a direct Force of *Attraction*, like drawing Plaisters in Chirurgery. And Betony, sternutatory Powders, and the like, put up the Nose, draw Phlegm and Water from the Head : and so Apophlegmatisms, and Gargarisms, draw the Rheum down by the Palate. And by this Virtue, some Purgatives may attract one Humour,

(3.)
Attraction.

its philosophical History, with regard to the Interpretation of Nature, and human Uses has not, perhaps, been greatly regarded. There are, however, some curious Papers relating to this Subject, in the *Philosophical Transactions* and *French Memoirs*. See also *Rhedi* of the Generation of Insects.

* And we might add, rather verified, than contradicted, by later Observation.

* For the Differences of Motions, See the *Novum Organum*, Part II. Sect. II.

Humour, and some another, according to the *received Opinion* ; as Rhubarb purges Choler ; Sena, Melancholy ; Agaric, Phlegm, &c. yet more or less, they draw promiscuously ^e. Note also, that besides a *Sympathy* between the *Purgative* and the *Humour*, some Medicines may draw one Humour more than another ; because some Medicines work quicker than others : those that draw quick, draw only the light and fluid Humours ; whilst those that draw slow, work upon the more tough and viscous. Men must therefore beware how they take *Rhubarb*, and the like Medicines alone, familiarly ; for such things carry off only the lightest part of the Humours, and leave the remaining Mass more obstinate ^f.

(4)
Flatulency. 4. The *fourth* Cause is *Flatulency* ; for *Wind* in motion moves to *Expulsion* : and, in effect, all *Purgatives* have a *raw Spirit*, or *Wind* ; which is the principal Cause of *Tortion*, and *Gripping*, in the *Stomach* and *Belly*. And therefore most *Catharticks* lose their *Virtue* by *boiling* ; and, for that reason, are given chiefly in *Infusion*, *Juice*, or *Powder* ^g.

Compression. 5. The *fifth* Cause is *Compression* ; as when *Water* is squeezed out of a *Sponge*. Thus the catching of *Cold* causes a *Looseness*, by contracting the *Skin* and external *Parts*. *Cold*, likewise, causes *Rheums* and *Defluxions* from the *Head* : and some *astringent Plaisters* squeeze out *purulent Matter*. This kind of *Operation* is not found in many Medicines. *Myrobalanes* have it ; and, *perhaps*, *Peach-bark* : for this *Virtue* requires *Astriction*, but such as is not grateful to the *Body* ; *pleasing Astriction* rather keeping in, than expelling the Humours : and therefore such an *ungrateful Astriction* is found in the things of an *harsh Taste*.

(6.)
Lubrication and Relaxation. 6. The *sixth* Cause is *Lubrication* and *Relaxation* ; as appears in *emollient Medicines* : for example, *Milk*, *Honey*, *Mallows*, *Pellitory of the Wall*, &c. There is also a *secret Virtue of Relaxation in Cold* : for the *Heat* of the *Body* binds the *Parts* and *Humours* together, which *Cold* relaxes : as we see in *Urine*, *Blood*, and the like ; which, when cold, break and dissolve ^h. And by this kind of *Relaxation*, *Fear* loosens the *Belly* ; because the *Heat* retiring towards the *Heart* ; the *Intestines*, and other *Parts*, are consequently relaxed. In the same manner *Fear* causes *trembling* of the *Nerves*. And of this kind of *Purgatives* are some *Preparations of Mercury*.

(7.)
Absterfion and Attenuation. 7. The *seventh* Cause of *Purging* is *Absterfion*, or *Scouring*, and *Attenuation* of the more viscous Humours ; rendering them more fluid, and cutting between

^e Partly thro' a want of Attention, and partly thro' a fondness for Simplicity, and the Humour of accounting for Things upon some one single Principle, this useful Doctrine of the Ancients is in danger of being laid aside by the Moderns. But the Distinction here made by the Author, may reconcile all Parties, if they would but attend to Nature ; and not indulge any particular Vanity in philosophizing. See the *Medicinal Works* of Dr. Frid. Hoffman.

^f Perhaps this *Deduction* is almost fitted for an *Axiom*.

^g Both Apothecaries and Physicians may receive considerable Information from this beginning of an Enquiry in their own Way ; and how much more, if it were duly prosecuted, extended, and transferred from *Purgatives* to *Alteratives*, *Cardiacs*, *Cephalics*, *Stomachics*, &c ? See the *Article* INFUSIONS.

^h Here seems to be an excellent Foundation laid, for that highly useful and important Enquiry into the Effects of Cold and Heat on the Body, with regard to Health and Sickness ; tho almost overlooked by Physicians.

between them and the Parts; as in the *nitrian Waters*; which wash Linen easily. But this cutting must be effected by Sharpness, without Astringent; as in *Salt, Wormwood, Oxymer, and the like.*

8. There are Medicines that move by Stool, and not by Urine; some by Urine, and not by Stool. Those that purge by Stool, are such as enter little into the Mesenteriac Veins; but either at first are indigestible by the Stomach, and descend immediately to the Guts; or else are afterwards rejected by the Mesenteriac Veins, and so again turn downwards to the Guts: and of these two kinds most Purgatives are. But those that operate by Urine, are such as are well digested by the Stomach; and well received also by the Mesenteriac Veins, whence they reach as far as the Kidneys: and these Medicines being opening and penetrating, promote the Office of the Liver, in driving down the Serum of the Blood to the Kidneys. For *Diureticks* do not work by *Rejection* and *Indigestion*, as *Solutives* do.

9. There are several Medicines, which taken in a greater quantity, move by Stool; and in a smaller by Urine: & *vice versa*. Of the former sort is Rhubarb. The Cause seems to be, that the Stomach in a small quantity digests and overcomes Rhubarb; as being neither flatulent nor loathsome; and so sends it into the Mesenteriac Veins; whence, being opening, it promotes Urine: but in a greater quantity, the Stomach cannot overcome it; and therefore it goes to the Intestines. *Pepper*, by some of the Ancients, is noted to be of the other kind; which taken in a small Dose, moves Wind in the Stomach and Guts, and so expels by Stool^k; but in a greater quantity dissipates Wind; and itself getting into the Mesenteriac Veins, thus passes to the Liver and Kidneys; where, by heating and opening, it provokes Urine in plenty^l.

C E M E N T S.

1. There is a *Cement* compounded of Flower, the Whites of Eggs, and powdered Stone, that becomes hard as Marble; wherewith the *Piscina Mirabilis*, near *Cuma*, is said to have its Walls plaster'd. And 'tis found, that the Powder of Load-stone and Flint, made into Paste, by the addition of Whites of Eggs and Gum-Dragon, will in a few Days acquire the Hardness of a Stone^m.

2. Certain

^l Has the Liver any Share in the Separation of the Urine?

^k Is *Pepper* certainly found to be *Purgative*, in a large Dose, and *Diuretick* in a small one?

^l Perhaps when this useful Enquiry comes to be duly prosecuted, and the method of Reason and Verification practised upon it, there may be found some small inaccuracies in what is here delivered; but the Doctrine, in general, seems the best that is extant, as following Nature close, without giving into Opinion, Hypothesis, or the vanity of any temporary Philosophy. And if this Method were to be carefully pursued, by proper Persons, for a few Years; could any Man question whether our present state of Physick would not be improved? But we seem to act as if we were not solicitous about the improvement of Medicine, or else despaired of it.

^m *Cements* are useful Things in *Arts* and *practical Philosophy*. Mr. Boyle mentions a few: but Operators generally keep them as Secrets. There is one made of a kind of Stone: barely by pulverizing

Cements and Quarries growing hard in the Air.

2. Certain *Cements* have been found very soft under the Earth, yet harden in the Sun, to the degree of Marble: and there are ordinary Quarries in *Somerſetſhire*, which cut soft to any bigness; and in the Building prove firm and hardⁿ,

C H A M E L E O N.

Observations upon the Chameleon.

The Chameleon is a Creature about the size of an ordinary Lizard: his Head unproportionably big, and his Eyes large. He moves his Head without turning his Neck, (which is inflexible) as a Hog doth: his Back is crooked; his Skin spotted with little Tumours, less eminent nearer the Belly; his Tail slender and long: on each Foot he has five Toes; three on the out-side, and two on the inside; his Tongue is of a great length in respect of his Body, and hollow at the end, which he will dart out to prey upon Flies. He is of a Green Colour; and a dusky Yellow, but brighter and whiter, towards the Belly; yet spotted with Blue, White and Red. If he be laid upon Green, the Green predominates; if upon Yellow, the Yellow predominates; but not so, if he be laid upon Blue, Red, or White; only the green Spots receive a more orient Lustre: laid upon Black, he looketh all Black, tho not without a mixture of Green. He feeds not wholly upon Air; tho that may be his principal Sustenance: For sometimes he catches Flies. Yet those who have kept Chameleons a whole Year together, cou'd never perceive them feed upon any thing, unless it were Air; and observed their Bellies swell, after they had swallowed down the Air, and closed their Jaws; which they commonly open against the Rays of the Sun^o.

C H A R A C T E R S of M A T T E R.

The Appetites, Passions, and Characters of Bodies.

The differences of *pressible* and *impressible*; *figurable* and not *figurable*; *mouldable* and not *mouldable*; *scissible* and not *scissible*; &c. are vulgar Notions, applied to the common Instruments and Uses of Men; but all them Effects of some of the following *Causes*. (1.) The *yielding* or not *yielding* of Bodies, so as to shrink into a smaller space, or preserve their external Bulk, and not fly back. (2.) The stronger or weaker Appetite in Bodies to Continuity. (3.) The disposition of Bodies to contract, or not to contract; to extend, or not extend. (4.) The small or great quantity of *pneumatical Spirit* in Bodies^p. (5.) The Nature of the *pneumatical Spirit*, whether Native, or only

pulverizing and mixing it with Water, that immediately Cements broken *Glass*, and *China Ware* with great Strength; and fits them for Use. So likewise a very large Bottle, broken into several pieces, may thus be set together again, and render'd useful, in two or three Minutes; as I have seen.

ⁿ With regard to this Subject, it were proper to enquire into the ancient Method of treating Stone, for Amphitheatres, Obelisks, &c. and if a kind of *artificial Stone* cou'd not be usefully introduced. See a late Pamphlet upon this Head. But let the simplest Methods be first followed. There is something extraordinary to be found in *Gypsum*.

^o Query, Whether any Information can be had from the History of the Chameleon, for the Condensation of *Air* into *Nutrient*? See the *Article A I R*.

^p The Doctrine of *pneumatical Spirits* seems at present discountenanced; thro' an Affection of accounting for all Things, upon simple, general, and mechanical Principles. But if Men are

ly common Air. (6.) The Nature of the native Spirits in the Body, whether active and eager, or dull and gentle. (7.) The emission or detention of the Spirits in Bodies. (8.) The dilatation or contraction of the Spirits in Bodies, while they are detained. (9.) The collocation of the Spirits in Bodies, whether equal or unequal; and whether the Spirits be collected or diffused. (10.) The density or rarity of the tangible Parts. (11.) The equality or inequality of the tangible Parts. (12.) The digestion or crudity of the tangible Parts. (13.) The nature of the Matter, whether *sulphureous* or *mercurial*, *watry* or *oily*, *dry* and *terrestrial*, or *moist* and *liquid*: For the *sulphureous* and *mercurial* Natures seem to be Radical, and Principal Natures⁹. (14.) The placing of the tangible Parts, lengthwise or transverse; more inward, or more outward, &c. (15.) The porosity or closeness betwixt the tangible Parts, and the size of the Pores. (16.) The disposition and position of the Pores¹.

CLARIFICATION.

1. Many Liquors are at first thick and turbid; as *Must*, *Wort*, express'd *The Causes of Clarification in* Juices of Fruits, Herbs, &c. but settle and clarify by Time. To fine them Liquors.

are in earnest; let them strictly enquire, whether these Spirits have not an actual Existence; and do not really perform many Operations, and produce many Effects in Nature? It must be observed that the word *pneumatical* does not signify *immaterial*: 'tis sufficient to make a Thing *pneumatical* that it be as light as Air. And let due Enquiry be made, whether all *pneumatical* Spirits are not a Composition of Air, intermixed with the subtile parts of Bodies, under the Form of a fine Effluvium? What is it in the Kernel of a Nut that exhales thro' the Shell, and leaves the Kernel shrunk and withered? What occasions stale Eggs to shrink from their Shell? How do violently purging and poisonous Plants lose their Virtue and Effect, and become innocent, by long keeping? What occasions Explosion in certain Chemical Operations; the swelling of Nitre in Distillation, &c? Let these Enquiries be pursued; and the Eye of the Understanding be kept ever fixed upon Nature.

⁹ Whence the Author intended *particular Enquiries* into them.

¹ What Author has duly searched out the particular Characters and Passions of Matter? 'Tis a most extensive part of Physicks, that remains to be derived from a close inspection of Natural Bodies; their different Forms, Tendencies, Endeavours, Relations, Affections, &c. For these are not hypothetical Things; nor to be idly resolved into Attraction, and Sympathy, mechanical Structure, and partial Notions of Philosophy: but to be investigated, register'd, and tabled. Chemistry has done something towards it; but the Enquiry stops short, and the Particulars have not been justly collected, marshalled, and drawn into Tables for Use. The Lord Bacon seems to have directed his Natural Enquiries principally this way; but who has follow'd him? Some Attempt should, at least, be made; and the general Properties of Matter be carefully distinguished from the particular. Are there not eight general Properties of Matter, common to all the Bodies in the Universe; viz. (1.) Extension; (2.) Impenetrability; (3.) Gravity; (4.) Figurability; (5.) Divisibility; (6.) Motion; (7.) Rest; and (8.) Communication of Motion? To these perhaps may be added; (9.) Solidity; and (10.) Elasticity; as all Fluids are possibly Solid and Elastic in their minutest Particles. These general Properties of Matter seem to have come under mathematical, rather than physical Consideration. But the particular Properties of Bodies are not to be found by Reasoning, Mathematicks, and the general Laws of Motion; but barely by diligent Experiment and Observation: such as the Attraction betwixt Light and Bodies, Water and Salts, Metals and Menstruums, Gold and Quicksilver, Aqua Regia and Gold, Spirit of Wine and Rosins, Sulphur and Oils, &c. 'Tis a careful Collection, and Arrangement, of these particular Laws of Bodies, that must let us into the secret Operations of Nature, and enable us to produce extraordinary Effects.

soon is a Capital Work; and a Spur to Nature, that makes her mend her pace: besides, it is of considerable Use in making Drinks speedily potable, and serviceable; but to discover the means of *accelerating the Operation*, we must previously know the *Causes of Clarification*.

Three Causes
of Clarifica-
tion.

2. The first Cause is, the *separation of the grosser Parts of the Liquor from the finer*. The second, the *equal distribution of the Spirits of the Liquor among the tangible Parts*: which always renders Bodies clear and untroubled. And the third is the *refining of the Spirit itself*; which thereby gives the Liquor more *Splendor and Lustre*.

Viz. (1.)
Separation.

(2.)
Distribution.

(3.)
And the Re-
finement of the
Spirit.

Racking.

3. (1.) *Separation* is effected by weight, as in the ordinary settling of Liquors; by Heat, Motion, Precipitation, Sublimation, Adhesion, and Percolation. (2.) The *even distribution of the Spirits*, is effected by a gentle Heat; by Agitation, or Motion; the admixture of some other Body, which has a power to open the Liquor, and to make the Spirits pass thro' it the better. (3.) The *refining of the Spirit*, is likewise effected by Heat; by Motion; and by the admixture of some Body, which has a power of attenuating.

4. 'Tis a common practice to draw Wine, or Beer, from the Lees, which we call *Racking*; whereby the Liquor will clarify much sooner: for the Lees, tho they keep the Drink in Heart, and make it lasting^f; yet throw up some spissitude: and this *Instance* is referable to *Separation*. On the other hand, it were proper to try what will be the Consequence of adding more Lees than its own to the Liquor; for *tho the Lees make the Liquor turbid, they refine the Spirits*^g. Take, therefore, two Vessels of new Beer; and rack the one from its Lees, and pour them into the unrack'd Vessel; and see the Effect^h. Put some quantity of stale Beer into new; and see whether it will not accelerate the Clarification, by opening the body of the Beer, and cutting the grosser Parts, whereby they may fall down into the Leesⁱ.

Brewing.

5. The longer that Malt, Herbs, or the like are infused in the Liquor, the more thick and troubled the Liquor becomes; but the longer they are boiled in the Liquor, the clearer it proves^j. The Reason seems plain; because

^f Do the Lees of fermented Liquors, after some certain Time, contribute to keep the Liquor alive; and make it more durable? Or is it not better, as well in *Malt-Liquors*, as in *Wines*, to rack, after the first Fermentation is over?

^g As Vintners find by Experience.

^h The Fermentation will be in some measure renew'd; and the Liquor afterwards become fine again. It is a common Practice, when Wines prove thin and poor, or begin to fall off, to add the Lees of richer Wines to them; whereby a considerable degree of Melioration is procured.

ⁱ Is not this a frequent Practice among the *Brewers*, or rather their *Coopers*? And in order to save their stale Beer for more useful purposes, do they not employ *artificial Acids*, for fining their Drink, and giving it that harshness, sharpness, and staleness of Taste, which enhances its Price? The common Practices of Tradesmen might considerably enrich our present operative Philosophy.

^j That is, *Decoction* makes a more thorough and intimate Solution than long continued Infusion; where the Liquor is clogged with more Matter than it can incorporate, and hold transparently dissolved, for want of Heat and Boiling.

because in *Infusion*, the longer the Operation continues, the more of the gross Body goes into the Liquor; but in *Decoction*, the more of this gross Matter goes out, yet it either purges at the top, or settles to the bottom: and therefore the most exact way of Clarifying, is, first to *infuse*, and then to draw off the Liquor and *boil* it; as they do for Beer: where Malt is first infused in the Water, and the Infusion afterwards boiled with the Hop ^z.

6. Put hot Embers about a Bottle, fill'd, almost to the neck, with new Beer: let the Bottle be well stopped; and renew the Embers every twenty ^{Experiments for clarifying} four Hours, for ten Days; then compare it with another Bottle of the same Beer set apart ^{by Heat and Motion, with regard to the even distribution and refining of the Spirits} ⁷. Take also Lime, both flaked and unflaked, and set Bottles in it as above. Let other Bottles be swung, or carried in a Wheelbarrow, upon rough ground, twice a Day: but then the Bottles should not be quite filled; for if the Liquor come close to the Stopple, it cannot play, nor flower. And when they are thus well shook, pour the drink into another Bottle, stopped close, after the usual manner; for if it continue with much Air in it, the drink will grow flat; and not settle so perfectly in all its parts ^z. Let it stand twenty four Hours; then put it again into a Bottle with Air; and thence into a Bottle stopped, as above: and so repeat the Operation for seven Days. Note, that in emptying of one Bottle into another, you must be quick, lest your drink pall. It were proper also to try this in a Bottle with a little Air below the Neck, without emptying.

7. With regard to *Percolation*, both *internal* and *external*, trial should be made of *clarifying by Adhesion*, as with Milk stirred into new Beer; for perhaps the grosser part of the Beer will cleave to the Milk: the doubt is, whether the Milk will separate again ^z. Also for the better clarifying by *Percolation*, when they tun new Beer, they pass it thro' a Strainer; and probably

H 2

* Is not this a vulgar Error in Practice? And might not all the Trouble and Expence of boiling the *Wort* be saved; to the great advantage of the Liquor? What the Author here alleges may amount to this; that a rich *Decoction* of Malt ferments, and clarifies, better than a thin *Infusion*: but cou'd not an Infusion of Malt be made as rich as is necessary; and thus, tho it fermented not so violently, yielded not so many Lees, or threw not up so large a head, be much more readily fermented, and fined, or made into a wholsomer, thinner, and brighter Liquor, than by *Decoction*? The Experiment has been tried with Success.

^y And if the Operation is well perform'd, the heated Liquor may become *Vinegar*; instead of clarifying and ripening in its own Form. But this Experiment is, perhaps, more instructive than if it were to have had the intended Success.

^z It may belong to this Enquiry to examine, what Effects the *London Drays* have upon the Beer they carry thro' the Streets; and whether the Liquor is not thus shook to Advantage; after being *cleared off* as they call it; and now made to ferment afresh, with considerable Violence; so as afterwards to fall fine the sooner, and ripen better: which seems to be the Case. And after finding the Effects of Motion and Heat; let the Enquiry be directed to Rest, and Coolness, in the business of fermented Liquors: for both these seem to have a considerable share in Clarification; insomuch, that after the *first Fermentation* is over, it is a practice among the curious, to remove their Liquors into cool Cellars: and perhaps the Cellar now cannot be too cool, if defended from *Winds* and *Frost*.

^a Milk, if thoroughly separated from its Cream, does not permanently unite with fermented Liquors, but usually curdles, and precipitates all their grosser Parts to the bottom: insomuch that a small addition of Milk perfectly well skimmed, will precipitate the Colour out of Red *Wine*, and leave it almost pellucid, like *Water*; tho without otherwise hurting the *Wine*.

bably the finer the Strainer is, the clearer the Liquor will become ^b.

Clarification
by Almonds.

8. In *Egypt*, they prepare, and clarify, the Water of the *Nile*, by putting it into great Stone Jars; and stirring it about, together with a few stamped Almonds, wherewith they also besmear the mouth of the Vessel; and after it has rested some time, draw it off. It were proper to try this Method of clarifying with Almonds, in new Beer; or Must, to hasten the Clarification ^c. See the *Articles*, DRINKS, MATURATION, and PERCOLATION.

C O L D.

The Production of Cold,
a noble Enquiry.

1. The *Production of Cold* is a thing very worthy of Enquiry; both for Use and the *discovery of Causes* ^d. For *Heat* and *Cold* are the two Hands of Nature. *Heat*, we have in readiness, from Fire; but for *Cold*, we must wait till it comes; or seek it in Caves or Mountains: and when all is done, we cannot obtain it in any great degree: for Furnaces are much hotter than the Summer's Sun; but Vaults, or Hills, not much colder than a Winter's Frost.

The Causes or
Means of producing Cold.

2. The *first* Means of producing Cold, is that of Nature, or the Expiration of it from the inward Parts of the Earth in Winter, when the Sun has no power to overcome it ^e.

3. The *second* Cause of Cold, is the Contact of cold Bodies; for Cold is active and transitive into Bodies adjacent, as well as Heat; as we see in those Things that are touched with Snow, or cold Water. And therefore, whoever would fully enquire into Nature, must resort to *Conservatories of Snow and Ice*; such as they use, for Delicacy, to cool Wine in Summer: which is a poor and contemptible Use, in respect of others that may be made of such Conservatories ^f.

4. The *third* Cause is, the primary Nature of all tangible Bodies: for all tangible Things are of themselves cold; unless they have an accessory heat by Fire, Life or Motion: even Spirit of Wine, and Chemical Oils, tho' so hot in Operation, are to the Touch cold: and *Air* itself condensed a little by blowing, is cold ^g.

5. The

^b No considerable Advantage can be well expected from external *Percolation* in clarifying fermented Liquors; as all Turbidity seems to proceed from a continuance, or renewal of their *Fermentation*: so that tho' a turbid fermenting Liquor were passed thro' a *Paper Filter*, or a *filtring Stone*, it presently grows turbid again. Internal *Percolation* therefore, or *Precipitation*, as by whites of Eggs, skimmed Milk, *Ising-glass*, &c. seems better adapted for the *Clarification* of these Liquors.

^c The Vintners sometimes make use of this Expedient: but are *Almonds* better for the purpose, than *skimmed Milk*; the *Whites of Eggs*; or *Ising-glass*? There is also said to be a certain Seed used upon the Coast of *Cormandel* and *Malabar*, for clarifying Water. See the *Philosophical Transactions*, N^o 249.

^d Observe, what has been fully explained in the *Novum Organum*; that to discover the *Causes of Things*, is finding the *Means to produce them*, whence *Causes*, and the *Means of Production* are convertible Terms.

^e What Instances are there to shew that Cold expires from the Earth?

^f See the *Author's* NEW ATLANTIS, and Mr. Boyle's *History of Cold*.

^g See *Boerhaave's Chemistry*, under the Chapter of Fire.

5. The *fourth* Cause is Density ; for all dense Bodies, as Metals, Stone, Glafs, are generally colder than others, and longer in heating than softer Bodies. But earthy, dense, and tangible Bodies, are of the Nature of Cold. For all tangible Matter being cold ; it follows, that where the Matter is most dense, the Cold is the greater.

6. The *fifth* Cause of Cold, is a quick Spirit ^a inclosed in a cold Body ; as appears from attentively considering Nature in many Instances. Thus, *Nitre*, which has a quick Spirit, is cold ; and colder to the Tongue than a Stone : *Water* is colder than Oil, as having a quicker Spirit : *Snow* is colder than Water, because it hath more Spirit : so Salt put to Ice, as in producing *artificial* Ice, increases the activity of Cold : so some Animals which have a quick *Spirit of Life*, as Snakes and Silk-worms, are cold to the Touch ; and so Quicksilver is the coldest of Metals, because fullest of Spirit.

7. The *sixth* Cause, is the Expulsion of Spirits, that have some degree of Heat : for the banishing of Heat must needs leave a Body cold ; as in the Operation of Opium, and Stupefactive, upon the Spirits of living Creatures.

8. *Seventhly*, the same Effect must follow upon the Exhalation of warm Spirits. *There is an Opinion* that the Moon is magnetical of Heat, as the Sun is of Cold and Moisture : it were therefore not amiss to try it with warm Waters ; the one expos'd to the Rays of the Moon, the other with some screen betwixt the Beams of the Moon and the Water ; as we use to the Sun for Shade ; thus to discover whether the former will cool sooner. It were also proper to enquire, what other means there may be, to draw forth the small degree of Heat which is in the Air ; for that may be a secret of great Efficacy in producing cold Weather ⁱ. See the *Articles*, AIR, COOLNESS, and HEAT.

COLOURS.

1. Metals give beautiful orient Colours, in Dissolution ; Gold gives an excellent Yellow ; Copper an excellent Green ; Tin an excellent Azure. So likewise in their Calces or Rusts ; as in *Vermilion*, *Verdigrease*, *Ceruse*, &c. and again, in their Vitifications : for by their strength of Body they endure the Fire, or *Aquæ fortes*, and are thereby put into an uniform Position, and still

^a This Introduction of Spirits has been already apologized for, and recommended to a particular Enquiry. See the *Article* AIR.

ⁱ This Enquiry is nobly prosecuted by Mr. Boyle ; but the Subject is so fruitful, as not to be still exhausted ; or the Causes of the Effect sufficiently discovered : and till they are, *Practical Philosophy* must needs remain imperfect. Nor were it easy to convince Men of the considerable Effects already produced by a proper application of Cold ; as particularly in the freezing of Wines, and other spirituous, and saline Liquors. See the *Essay* lately published upon this Subject ; entitled, *An Essay for Concentrating Wines, and other fermented Liquors, or taking all the superfluous Water out of them to Advantage.*

still retain part of their *principal Spirit* ^k; which two Particulars are chiefly required to make Colours bright and lightsome ^l.

Of altering
the Colour of
Hair and Fea-
thers.

2. Living Creatures generally change their Hair with Age, some earlier and some later; thus dappled Horses turn white; old Squirrels grisly; &c. Cygnets turn from grey to white; Hawks from brown to white: and some Birds change their Colour upon Moulting; as the Robin-red-breast, after Moulting, grows Red again by degrees: so do Gold-finches upon the Head. The Cause may be, that *Moisture* chiefly colours Hair and Feathers; but *Dryness* turns them Grey and White: for Hair in Age grows drier; so do Feathers. But Feathers after Moulting, are young; or the same as the Feathers of young Birds. So the Beard being younger than the Hair of the Head, usually grows Hoary later. Hence one might devise means of altering the Colours of Birds; and preventing Grey-hairs ^m.

C O M P R E S S I O N.

The Compres-
sion of Li-
quors.

It has been observed, that a large Vessel of Liquor, being drawn out into Bottles; the Liquor returned into the Vessel, would not fill the Vessel again, so full as it was; and that this holds more in Wine than in Water. The Cause may be trivial; or the Liquors sticking to the sides of the Bottles: but, perhaps, also the Liquor in the Vessel is not so much compress'd as in the Bottles; because in the Vessel it meets with Liquor chiefly; but in the Bottles a small quantity of Liquor meets with a large Surface in the sides of the Bottles, which may compress it so, that it shall not expand again ⁿ.

C O N -

^k That *Metals* should hold a *Spirit*, will sound very odd to many. The Author produces several *Instances* for it. He does not however desire we should rest in them; but recommends all to further *Enquiry*, and consequent *Verification* or *Rejection*. See the *Articles*, *FIXATION*, *HEAT*, *NATURE*, and *SPIRITS*.

^l Tho the business of Colours may seem to have been abundantly prosecuted, by several eminent Enquirers; yet there are many Particulars in it that require a farther discussion; especially with regard to *Practice*: which is the thing that tries the Validity, the Perfection, and the Usefulness of Discoveries. But several Arts depending upon Colours; as Painting, Dying, Callico-Printing, &c. are deficient in many particulars, for want of a thorough and commanding Knowledge in this Subject. Thus the making of *fixed and permanent mineral, or metalline Colours*, without *Acids* and *Alkalies*, is a *Desideratum*; the foundation for supplying which, may seem here laid by the Author. It also deserves a particular Enquiry, how the Business of Colours stands with the *Chinese*.

^m For a beginning to this Enquiry, See the Article *TRANSMUTATION*: but who has continued it?

ⁿ Has quantity of Surface a power of Compressing? Or what Force is capable of compressing Liquors? But for the *Phenomenon* itself, is not the principal Reason of it, the Exhalation of the more subtle Parts of the Liquor in the Operation; whilst a slender Stream of the Liquor exposes a large Surface to the Air, for a considerable Time? The Fact appears tolerably verified by the Experience of Vintners, and Distillers; particularly the latter, who find a considerable waste of their high rectified Spirits, by measuring them out of one Vessel into another: and no wonder, as Spirits evaporate faster, and rise much sooner in Distillation than Water. And thus a Quantity of Proof-Brandy left in a Cup, exposed to the Air for a few Days, will be reduced to Phlegm; and lose half its original Quantity, which was chiefly *Spirit of Wine*.

CONCOCTION.

1. The Word *Concoction*, or *Digestion*, is chiefly taken from Observation upon living Creatures, and their Organs ; and thence transferred to Liquors, Fruits, &c. Thus Men speak of *Meat concocted*, *Urine* and *Excrements concocted* : and the four *Digestions* ; viz. in the *Stomach*, *Liver*, *Arteries*, *Nerves*, or in the several Parts of the Body, are likewise called *Concoctions* : and all are made the Works of *Heat*. These Notions are but ignorant Catches at a few things that lie more obvious to Mens Observation. The most constant Notion of *Concoction* is, to signify the degrees of Alteration of one Body into another, from *Crudity*, to the ultimate *Action*, or *Process*, which is *perfect Concoction*. Whilst a Body to be converted, is too strong for the Efficient that should convert it, that Body remains *crude* and *inconcocted*, and the Process is to be called *Crudity* and *Inconcoction*. 'Tis true, *Concoction* is, in great part, the Work of *Heat*, but not of *Heat* alone ; for all things that promote *Conversion*, as Rest, Mixture of a Body already concocted, &c. are also means of *Concoction*. *Concoction and Crudity explained.*

2. There are two *Periods of Concoction* ; the one *Assimilation*, or absolute *Conversion* ; the other, *Maturation* : the former is most conspicuous in *Animal Bodies* ; where there is an absolute *Conversion* and *Assimilation* of the Nourishment into the Body : likewise in the Bodies of *Plants* ; and again, in *Metals* ; where there is a full *Transmutation*. The other, which is *Maturation*, appears in *Liquors* and *Fruits* ; where there is not desired, nor pretended, an utter *Conversion* ; but only an *Alteration* to that Form, which is most proper for human Use ; as in the clarifying of Drinks, ripening of Fruits, &c. *Two Periods of Concoction.*

3. But there are two kinds of *absolute Conversions*. The one is, when a Body is converted into another before existing ; as when Nourishment is turned into *Flesh* ; which we call *Assimilation* : the other, when the *Conversion* is into a new Body that did not præ-exist ; as if *Silver* should be turned into *Gold*, or *Iron* into *Copper* : and this *Conversion* is better, for Distinction sake, called *Transmutation*. See the Article ALTERATIONS. *Two kinds of absolute Conversions.*

CONCRETION.

Concretions of Bodies are generally resolved by the contrary Agent. Ice, which is Water congealed by Cold, is dissolved by Heat : and Salt and Sugar, which are made by Heat and Dryness, are dissolved by Cold and Moisture. *The Cause of Concretion and Dissolution in Bodies.*
The

P Are there not many *true Concoctions* performed without any *sensible Heat* at all ? Let a particular regard, in this Enquiry, be had to *Menstruums*.

^a Tho not perhaps for the sake of the Thing itself, and the Service of Philosophy as by reason of an Abuse of the Word ; *Transmutations* are, indolently, reckoned *Impossibilities*. The Force of Distinction in Philosophy, is great. And thus to distinguish betwixt *Assimilatory*, and *Transmutatory* Operations, may prove eminently serviceable ; as *Assimilations* are not denied : and as, perhaps, all the pretended *Transmutations* may come under *Assimilations*. But there are few who could bear to hear this Doctrine explained : and, perhaps, the best Explanations are *Works*, and *palpable Instances*.

The *Cause* is, that these Operations are rather *Returns* of the Bodies to their former Natures, than *Alterations*: whence the contrary Operations are the Cure. But Oil neither easily congeals with Cold, nor thickens with Heat; because the *Spirit of the Oil*[†], by either means, exhales little: for Cold keeps it in; and Heat, unless vehement, does not call it forth. As for Cold, tho' it take hold of the tangible Parts, yet it rather makes the *Spirits* swell, than congeals them; as when Ice is congealed in a Cup, it swells instead of contracting, and sometimes breaks the Cup[‡].

C O N G E L A T I O N .

An Experiment for the Congealing of Water into Crystal.

'Tis credibly reported, that in deep Caves there are pensile Crystals, and degrees of Crystal, that drop from above; and, in some others, rise from below[†]: and tho' this be chiefly the Work of *Cold*[‡], yet, perhaps, the Water that passes thro' the Earth, acquires a Nature more clammy, and fitter to congeal, and become solid, than Water of itself[§]. Therefore expose a heap of Earth^{||}, to violent Frosts, laid upon a hollow Vessel; placing a Canvas between, to prevent the Earth from falling in: and pour Water upon it, in such quantity as to soak thro'; and see whether it will not make a harder Congelation at the bottom of the Vessel; and less apt to dissolve than ordinary. I suppose also, that if the *Earth* be made narrower at the Bottom, than at the Top, in the Fashion of a Sugar-loaf inverted, it will help the Experiment: as making the Ice less in Bulk, where it issues; for *Smallness of Quantity is a Help to Transmutation*^{*}.

C O N T R A C T I O N .

Whether Water will contract?

It is strange, how the Ancients took Experiments upon Trust; and yet built great Matters upon them. 'Tis confidently delivered, by some of their best Writers, that a Vessel filled with Ashes, will still receive the same Quantity of Water it would have done without the Ashes. But this is *utterly false*; for the Water will not go in by a fifth Part: which, I suppose, is the Quantity of Difference between the Ashes lying close, and loose: for Ashes alone, if hard pressed, lie closer; but with Air between them, looser; and, with Water, closer again. For I have not certainly

[†] The Author continually proceeds upon the Existence of *Spirits*, in all kinds of Bodies: it were therefore proper, for general Satisfaction, and the sure Discovery of the Truth, that a particular Enquiry were instituted about the *Spirits of Bodies*. The first Heads for such a History might easily be drawn out; but who will prosecute and fill them up?

[‡] This has been thought a late Discovery.

[§] M. Tournefort has a remarkable Paper to this Purpose in the *French Memoirs*.

^{||} Is Crystallization the Work of Cold, or not rather of Temperature, somewhat inclining to Coolness? Let Nature, and Experience, be consulted.

^{*} This Conjecture seems derived from Experience, or, at least, comports well with it. See *Stahl's Principles of Chemistry*: and make trial of earthy Waters; or such as have passed thro' Lime-stone, &c.

[†] Let the Earth be not *Mould*; but *calcareous*. And have we not a natural Instance of the thing in some old Walls; where Water straining thro' the Mortar, becomes a hard concremented Substance? Let Enquiry be made into the *Nitrum Murale*, or *Calcareous Nitre* of Dr. Lister.

[‡] This perhaps might deserve to pass for an *Axiom*.

certainly found, that Water will contract, by being mixed with Ashes, or Duft ^r.

COOLNESS.

'Tis practised in *Gaza*, as a Contrivance for Coolness in great Heats, to ^{Ways of gathering Wind for Freshness,} bed Vessels of Earth in the Walls of their Houses, to gather Wind from the Top, and convey it down, thro' Spouts, into the Rooms. And, 'tis said, there are some Rooms, in *Italy* and *Spain*, for Freshness, and gathering the Wind in the Heats of Summer : but these are Ways of penning in the Wind, and setting it loose again ; so as to make it reverberate, and go round in a Circle ; rather than the former Device, of Spouts in the Wall ².

CORAL.

In the Sea, to the Southwest of *Sicily*, is found plenty of Coral. 'Tis ^{The Growth of Coral,} a submarine Plant, that hath no Leaves : it branches, only, when under Water ; 'tis soft, and of a green Colour ; but being brought into the Air, becomes hard, and shining red. 'Tis also said to have a white Berry ; but we find not the Berry brought over with the Coral. Perhaps 'tis cast away as useless. *Enquire better of it, to discover the Nature of the Plant* ².

D.

DEFORMITY.

I *T is reported,* that if Whelps, or other young Creatures, be put into a Box, this prevents their growth in Height, and makes them increase in Breadth or Length ; as they have room : *if this be practicable,* and the Creature, so pressed, survives the Operation ; it may be a means of producing dwarf Animals of a very strange Figure. This is certain, that Pressure, or Moulding the Parts of Creatures, whilst they are very young, considerably alters their Shapes : as stroking the Heads of Infants was noted of old to make the *Macrocephali* ; a long shaped Head being at that time in esteem : and the raising, gently, the Bridge of the Nose, prevents the Deformity of a Saddle-nose. Which Observation, well considered, may teach a Method of making the Bodies of Men and Women, in many respects, more comely, and regular, than they would otherwise be ; viz. by

V O L. III. I Form-

¹ What is the *Fact*, with regard to the Contraction, or Dilatation of Liquors, upon the Addition of dry Bodies to them, that either dissolve, or remain undissolved therein ? If an Ounce of Sugar were dissolved in a Pint of Water, how much higher will the Water rise in a hollow graduated Cylinder ? There seems to be some Subtlety in this Affair, not yet clearly comprehended ; perhaps for want of justly distinguishing betwixt Continuity and Contiguity, Mixture, Solution, Aggregation, and Texture. See Dr. Stahl upon the Subject. See also, an Experiment to this purpose in the *Philosophical Transactions*, Numb. 331. where two Liquors are shewn to possess less Space upon mixing.

² See more to this purpose in the Author's *History of Winds*.

• Particularly consult Mr. Boyle, and Count Marigli, upon this Head.

Forming and Moulding them in Infancy : as by stroking up the Calves of the Legs, to keep them from falling too low ; and by stroking up the Forehead, to keep it from sinking^b. It is a common Practice to swathe Infants, that they may grow better shaped ; and, young Women, by wearing streight Stays, keep themselves from being grofs and corpulent^c.

DIVINATION.

*An Enquiry
begun, into nat-
ural Divina-
tion and Dis-
covery.*

1. All Bodies have *Perception*, tho, not *Sense*: for when one Body is applied to another, there ensues a kind of Election, either to embrace, or expel^d; and whether the Body be alterant, or altered, *Perception constantly precedes Operation*; otherwise all Bodies would be alike^e. And this *Perception*, in some kind of Bodies, is so exquisite, that the *Sense* is dull, in comparison of it. Thus the Thermometer will shew a minute Difference of Heat, or Cold, which the human Feeling cannot discover. And this *Perception* appears sometimes at a Distance, as well as upon Touch: for Example, when the Loadstone attracts Iron; or Flame the *Naphtha* of *Babylon*, afar off^f. It were, therefore, a noble Enquiry to discover the more subtle *Perceptions* of Bodies; for this would prove another Key to open Nature, as well as the *Sense* does; and sometimes better^g. Besides, 'tis a principal Means of NATURAL DIVINATION; for what appears early, in these Preceptions, follows long after in great Effects. It will also serve to discover what is hid, as well as to foretel what is to come. Thus the *Sense* cannot inform us, whether Seeds be old or new; but upon the Experiment of steeping them in Water, the new ones will sprout sooner. So the *Taste* cannot discover the best Water; but the quick Evaporation of it in Boiling, and many other Experiments, will discover it. So in *Physiognomy*, the Lineaments of the Body

^b Let Enquiry be made, whether inveterate Distempers, arising from an ill Conformation of the Parts, have not been cured by dry Friction, or Stroking. Has not a *Straitness of the Chest*, and a *Relaxation of the Uvula*, been helped by this means? Have not extraordinary Cures in Chirurgery been made by proper Bandages, and Rolling? Instances of this kind should be collected, as primary Parts of the Enquiry. that shew the Power of Art, and tend to increase it; for what has once been done, may be done again.

^c Men can never expect to know what may be done in this Way, without a careful Enquiry into the Subject; and discovering prudent, rational, and effectual Methods for putting the thing in practice. But we seem to dread the Enquiry; as if childishly afraid of acquiring and exerting a Power over Nature. Till this Charm is broke, we must take our Bodies as the Nurse is pleased to swaddle and fashion them.

^d Is this meant of the general Law of *Attraction* and *Repulsion* in Bodies; or rather of particular Relations betwixt particular Bodies?

^e This is an important Observation, and requires to be thoroughly verified, extended, and enriched, by all the eminent Instances that can any way be collected.

^f Is this Tradition of the *Naphtha* verified? If more Instances are wanted, observe the Snuff of a Candle newly blown out, and applied near to the Flame of another Candle: the Catching of *Spirit of Wine*, Oil of Turpentine, Calico, &c. upon the approach of Flame; the near approach of two Drops of Water upon an Oil-cloth; of two Particles of Quicksilver upon a Board, &c. But a more eminent Instance of this kind, is seen in the *Attraction of Glass*, which will operate to the Distance of many Yards, by the help of Friction and a proper String; as Mr. *Steven Gray* has lately shewn.

^g It cannot, perhaps, be too much observed, that the View of the Author is, not only to enquire himself, but more directly to set Mankind upon enquiring.

Body will discover those *natural Inclinations* of the Mind, which Dissimulation may conceal, or Discipline suppress ^a. *Divination*, indeed, is attained by other Means ; so that if we know the Causes, and the Concomitants, we may judge of the Effect to follow ; and the like may be said of Discovery : but we here chiefly consider that *Divination* and *Discovery*, which is to be had from an early or subtle *Perception*.

2. The Tendency of *Air*, or *Water*, to corrupt or putrefy, may doubtless be found, before it breaks out into manifest Effects ; as the producing Diseases, Blasts, or the like. Great and early Heats in the Spring, without Winds, portend a pestilential Season ; and, generally, so do Years with little Wind or Thunder. Great Droughts in Summer, lasting to the end of *August*, and some gentle Showers upon them, and then dry Weather again, portend a pestilential Summer, the Year following ; for, about the end of *August*, the Sweetness of the Earth, which goes into Plants and Trees, is exhaled ; so that nothing then can breathe from the Earth, but a gross Vapour ; which is apt to corrupt the Air : and this Vapour, by the first Showers, if gentle, is released, and comes forth abundantly. Whence those who go out into the Air, soon after such Showers, are often taken sick ; and, in *Africa*, they do not stir out of Doors soon after the first Showers. But if the first Showers prove violent, they rather wash and fill the Earth, than suffer it to breathe forth presently. And if dry Weather return, this fixes and continues the Corruption of the Air, begun upon the first Showers, and makes it unwholesome, even to the next Summer : unless a very frosty Winter discharge it ; which seldom succeeds such Droughts. The lesser Infections of the *Small-Pox*, *Purple Fevers*, *Agues*, &c. in the preceding Summer, and hovering all the Winter, portend a great Pestilence the following Summer ; for Putrefaction rises not to its Height at once. It were proper, to lay a Piece of raw Flesh, or Fish, in the open Air ; and if the Matter putrefy quickly, it may be accounted a Sign of a Disposition in the Air to Putrefaction. But, to be informed whether the Putrefaction is quick, or slow, compare this Experiment with the like made in another Year. It were also proper, in the same Year, and at the same time, to lay one Piece of Flesh in the open Air ; and another of the same kind and size within Doors : for if there be a general Disposition in the Air to Putrefaction, probably, the Flesh will sooner putrefy abroad, where the Air has more power ; than in the House, where it has less. And this Experiment should be made about the end of *March* ; that Season being likeliest to discover what the Winter has done, and what the following Summer will do, upon the Air. And because the

I 2

Air

^a Men do not, perhaps, sufficiently consider how few capital Discoveries can be made in Nature by the direct Use of the *Senses*. Certainly the unassisted Senses reach not below the Surface of Things : but *Experiments* go deep, and as the Author expresses it, enter the Bosom of Nature. See the *Preliminaries* to the *Augmentis Scientiarum*, Sect. II. 5—10 ; and the *Notum Organum*, passim.

¹ Does an *atural Sweetness* ascend from the Earth into Vegetables ? or are the Juices of the Earth converted, and rendered sweet, by the Operation they undergo in *Plants*, *Flowers*, and *Fruits* ?

Air receives a great Tincture and Infusion from the Earth, it were proper to try the Experiment, both upon a Pillar, or Pole of Wood, some height in the Air; and upon the Earth's Surface. Try whether *May-dew* will putrefy quickly, or no; for that, likewise, may disclose the Quality of the Air, and Vapour of the Earth. A dry *March* and a dry *May*, portend a healthful Summer; if there be a showery *April* between: otherwise, 'tis a Sign of a pestilential Year^k.

Directions to
try the Air of
Places.

3. To discover the *Disposition of the Air*, is of still more Use for the choice of *dwelling-Places*; at least, for Lodges, on account of Health. And, in this case, 'tis proper to make trial, not only of the Aptness of the Air to corrupt; but also of its Moisture, Dryness, and Temper, as to Heater Cold. In some Houses Sugar will relent, and baked Meats grow mouldy, sooner than in others; and the Wainscots will also sweat in some more than in others, so as almost to run with Water: all which are chiefly caused by the Moisture of the Air. To examine this Matter: before a House is built, expose Wool, or a Sponge, in the place you would try; and comparing it with other Places, see whether the Substance exposed does not grow moist, or gain in weight; and judge of the place accordingly. So in some Places, either from the Nature of the Earth, or the Situation of Woods and Hills, the Air is more unequal than in others: and, as Inequality of Air is an Enemy to Health; set two similar Thermometers in different Places, the same Hours of the same Day, where no Shade nor Enclosures are; and mark to what height the Liquors rise; and if you find them rise unequally, conclude the place where the Liquor rises highest to be the warm Air, and the other the colder; and this in proportion to the Difference^l.

Attempts for
predicting cold
Winters, and
hot Summers.

4. The *Means of predicting cold and long Winters, and hot and dry Summers*, should likewise be sought; as well for the Discovery of the *Causes*, as with regard to *Provisions*. (1.) If Wainscot, or Stone, that uses to sweat, be drier in the beginning of Winter, or the Eaves of Houses drop more slowly than ordinary; it portends a hard and frosty Winter: for it shews an Inclination of the Air to dry Weather; which, in Winter, is always joined with Frost. (2.) Generally, a moist and cool Summer portends a hard Winter; because the Vapours of the Earth not being dissipated by the Sun, in the Summer, they rebound upon the Winter^m. (3.) A hot and dry Summer and Autumn, especially if the Heat and Drought extend far into *September*, portends an open beginning of Winter; and Cold to succeed,

^k This Enquiry has been little prosecuted; tho Dr. Sydenham, and Mr. Boyle, have done somewhat in it. There seems still wanting, a competent Set of Observations upon the Weather, the Meteors, and the various Phenomena, Changes, and Revolutions in the Atmosphere; with a direct View to the Causes thereof. For so long as we remain ignorant of *Causes*, we can never safely predict, and govern *Effects*. Whence the principal Endeavours of the Author, in this Piece, are justly directed to the *Investigation of Causes*; so far as they are knowable.

^l This Subject has been prosecuted, in some degree, by particular Persons; but not with that Variety of Experiments the Thing requires. See Mr. Boyle's *Memoirs for a general History of the Air*.

^m How does this agree with what was just before observed, That Dryness occasions a hard Winter?

succeed, towards the latter part of the Winter, and the beginning of the Spring: for till then, the former Heat and Drought preside; and the Vapours are not sufficiently multiplied. (4.) A warm, open Winter, portends a hot and dry Summer; for the Vapours disperse into the Winter Showers: whereas Cold and Frost keep them in, and convey them to the late Spring, and following Summer. (5.) Birds that change Countries at certain Seasons, if they come early, shew the Temper of the Weather, according to the Country whence they came: as the Winter-Birds; viz. Woodcocks, Feldfares, &c. if they come early, and out of the Northern Countries, with us, shew cold Winters. But, in the same Country, Birds shew a Temper of Season, like to that wherein they come; so Swallows, Bats, Cuckoos, &c. which appear towards Summer, if they come early, shew a hot Summer to follow^a.

5. The more *immediate Prognosticks of Weather, to follow soon after*, are more certain than those of Seasons. The Resounding of the Sea upon the Shore; and the Murmur of Winds in the Woods, without apparent Wind; shew Wind to follow: for such Winds breathing chiefly out of the Earth, are not, at the first, perceived, unless pent up by Water or Woods; and therefore a Murmur out of Caves, likewise, portends the same. The upper Regions of the Air, *perceive* the Collection of the Matter of Tempests and Winds, before the Air below: and therefore the Obscuration of the smaller Stars, is a Sign of a Tempest. Great Mountains *perceive* the Disposition of the Air to Tempests, sooner than the Valleys, or Plains below: hence, they say in *Wales*, that when certain Hills have their Night-caps on, they fore-bode Mischiefs. The *Cause* may be, that Tempests, which are commonly bred above, in the middle Region, as they call it, are soonest perceived to collect in the places near it. The *Air* and *Fire* have *subtile Perceptions* of a rising Wind, before Men find it. The Trembling of a Candle will discover a Wind, that, otherwise, we feel not; and the Curvature of Flame, shews the Air beginning to fluctuate: and so do Fire-coals, by casting off the Ashes more than usual. The *Cause* may be, that no Wind is at first, till it hath struck and driven the Air, apparent to the Sense; but Flame is easier to move than Air: and for the Ashes, no wonder if an unperceived Wind should shake them off; since we commonly try which way the Wind blows, by throwing Grass or Chaff, or such light things, into the Air.

The Prognosticks of Weather near at hand; taken, (1.) From above.

(2.) *From Fire and Air.*

6. When *Wind breathes from under the Sea*, as it causes a Resounding of the Water, so it does some light Motion of Bubbles, and white Circles of Froth: for the Wind cannot be perceived by the Sense, till there is an Eruption of a great Quantity from under the Water, so as to collect into a Body: whereas, at first, it comes but in small Portions. And any light thing

(3.) *From the Sea.*

^a Should it not be carefully observed, for a Series of Years, what degree of Truth and Certainty there is in these kind of Aphorisms, in order to their being made *Rules and Canons*?

^o These kind of Observations lay a Foundation for discovering, as it were, the premeditated Acts of Nature, from slight Intimations; and may, doubtless, be carried to a great length, if Men will not be wanting to themselves.

thing that moves, when we find no Wind, shews a Wind at hand; as when Feathers, or the Down of Thistles fly about in the Air.

(4.) *From Animals.* 7. As for *Prognosticks of Weather from Animals*, let it be noted, that Creatures living in the open Air, must needs receive a quicker Impression from the Air than Men, who dwell chiefly within Doors: and especially Birds, that live in the freest, and clearest Air; and are aptest, by their Voice, to tell what they find; and likewise express it by the Motion of their Flight. *Water-Fowls*; as *Sea-gulls*, *Moor-hens*, &c. when they flock, and fly together from the Sea towards the Shores; and *Land-Birds*; as Crows, Swallows, &c. when they fly from the Land to Water, and beat the Waters with their Wings; fore-shew Rain and Wind. The Cause may be, the Pleasure that both Kinds take in the Moisture and Density of the Air; thence desiring to be in Motion, and upon the Wing, whithersoever they would otherwise go: for, no wonder, if Water-Fowl delight most in that Air which comes nearest to Water: and many Land-Birds, also, delight in Water, and a moist Air. For the same Reason also, many Birds prune their Feathers; Geese gaggle; and Crows seem to call upon Rain: all which is expressing the Pleasure they seem to receive in the relenting of the Air. The *Heron*, when she soars high, shews Winds: but *Kites*, flying aloft, shew fair and dry Weather. The Cause may be, that they both mount most into the Air of that Temper wherein they most delight. The *Heron*, being a Water-Fowl, takes pleasure in dense Air; and being but heavy of Wing, requires the help of the grosser Air. But the *Kite* affects not so much the Grossness of the Air, as its Coldness and Freshness; for being a Bird of Prey, and therefore hot, she delights in the fresh Air, and often flies against the Wind; as *Trouts* and *Salmons* swim against the Stream. Yet all Birds may find Ease in high Air; as Swimmers do in deep Water: for, when aloft, they sustain themselves by the spread of their Wings, without Motion.

(6.) *Fishes.* 8. *Fishes*; when they play towards the Top of the Water, commonly foretel Rain. The Cause may be, that a Fish hating Dryness, will not approach the Air till it grows moist; and when 'tis dry will avoid it, and swim lower.

(7.) *Beasts.* 9. *Beasts* generally delight in a moist Air; which makes them feed the better: whence, Sheep will go early in the Morning to feed against Rain. Cattle, Deer, and Rabbits, also feed hard before Rain: and a Heifer will toss up her Nose, and snuff in the Air against Rain.

(8.) *Plants.* 9. *Trefoil* swells in the Stalk against Rain, and so stands more upright; for, by wet, the Stalks of Plants rise up, and the Leaves bow down. A small red Flower grows in the Stubble-fields, and called by the Country People *Wincopipe*; which, if it open in the Morning, a fair Day is sure to follow.

10. Even

p What is the Botanical Name and Nature of this Flower? If it afford any such certain Indication of the Weather, it may be worth enquiring after. There are several late Inventions for discovering the Moisture of the Air; as by suspending a Sponge at one End of a Balance; with Weights in a Scale at the opposite End: the exposing of strong Oil of Vitriol

10. Even in *Men*; Aches, Hurts, and Corns, are more sensible either towards Rain, or Frost: the one causing the Humours to abound; and the other making them sharper: whence both Extremes will bring the Gout. (9.)
Men.

11. *Worms, Vermin*, &c. also foreshew Wet: for Earth-worms will creep out, Moles cast up, and Flies bite more, against Rain. (10.)
*Worms, and
Vermin.*

12. Solid Bodies also fore-shew Rain; as Stones and Wainscot, when they sweat: and Boxes, and wooden Pegs, when they draw out and wind hard; tho the former be but from an external Cause; the Stone or Wainscot, turning and beating back the Air against itself: but the latter proceeds from an internal Swelling in the Body of the Wood &c. See the *Articles* WEATHER and WINDS. (11.)
Solid Bodies.

D R I N K S.

They have in *Turkey*, and the *East*, certain Confections called *Servets*, *The Turkish Drinks*, which are like candid Conerves, and made of Sugar and Lemmons, Sugar and Citrons, or Sugar and Violets, and some other Flowers, with a Mixture of Ambergreese, for the more delicate: and by dissolving these in Water, they make their Drinks; being forbid the Use of *Wine* by their Law. But it may seem strange, that no *Englishman*, *Dutchman*, or *German*, should set up Brewing in *Constantinople*; considering the *Turks* have such a Quantity of Barly. Frugality might, indeed, recommend the drinking of Water, to the Generality; but the Better-fort might well be at the Expence of Malt-Liquor. This want of Malt-Liquor among the *Turks*, however, is the less to be wondered at, because *France*, *Italy*, and *Spain*, have not yet given into the Use of Beer or Ale; which, perhaps, if they did, would mend both their Health and their Complexions. 'Tis likely to be a profitable Attempt to any one who should begin Brewing in *Turkey*. See the *Articles* CLARIFICATION, and MATURATION.

D R U N-

to the Air: the fixing of a Wheat-beard, to move like the Index of a Dial, &c. But what do they really indicate with regard to the actual Change of Weather? Do they not rather denote the proportionable Quantity of Moisture in the Air?

⁹ Most of these Particulars are put into the Road of a proper Enquiry, and Examination, in the Author's *History of Winds*; and till that History be duly prosecuted, and the true Interpretation of Nature pursued, but little Precision can be rationally expected in the Subject. See Mr. Boyle's *Philosophical Pieces*, the *Philosophical Transactions*, the *French Memoirs*, &c. But it is of a greater Importance to consult Nature herself; and procure better Information from careful *Observations*: which are to be ranged and ordered, according to the Directions of the *Novum Organum*.

[†] 'Tis not easy to be credited, without Trial, how pleasant a Liquor may be made in this Way; and, by an easy Encheiresis, how nearly approaching to the finest Wines.

[†] We find it in the Nature of Men to extol some one thing above all others; and this frequently to a degree of Superstition and Bigotry. Thus some write Panegyrics upon *Water*; some upon *Wine*; and some upon *Malt-Liquors*, to the Disparagement of the rest. But who enquires soberly into these Things; and gives to each its just share of Merit? Have not all the Liquors their proper Uses, under due Regulation? And may not *Water*, in some Cases, be justly preferred to *Malt-Liquors*; *Malt-Liquors* to *Wine*, and *vice versa*? Surely these things deserve to be settled by Experience and Reason; and should not be left fluctuating at every one's Caprice.

[†] For the *Turks* might be glad of any Pretext to indulge themselves in Spirituous Liquors, that could not well be construed *Wine*, or the Juice of the Grape.

D R U N K E N N E S S .

*Drunken Men
unprolifick.*

1. 'Tis generally allowed, that the Sperm of drunken Men is unfruitful : the Cause may be, that 'tis over-moistened, and wants Spissitude^u. And we have a merry Saying, *That they who go drunk to Bed, beget Daughters.*

The Phenomena of Drunkenness, with Conjectures at their Causes.

2. Drunken Men are taken with a Defect in voluntary Motion ; they reel, they tremble, they cannot stand, nor speak, strongly : because the Spirits of the Wine oppress the animal Spirits, occupy part of their place, and so make them weak, and less able to move. Hence drunken Men are apt to fall asleep : and Opiates and Stupefactive induce a kind of Drunkenness, by the grossness of their Vapour ; as Wine does by its quantity of Vapour. Besides, they rob the animal Spirits of the Matter whereby they are nourished : for the Spirits of the Wine prey upon this Matter, as well as the animal Spirits do : and thus make the animal Spirits less apt for Motion.

3. Drunken Men, (1.) imagine all turns round ; and (2.) that external things are coming upon them ; (3.) they do not well discern Objects afar off ; and (4.) those they see near at hand, they see out of their places ; and (5.) sometimes double. (1.) *They imagine that Things turn round* ; because the Spirits themselves turn ; being compress'd by the Vapour of the Wine : for all Fluids turn upon Compression ; and it is the same to the Sight, whether the visual Spirits move, or the Object, or the Medium. And long turning round, causes the same Imagination. (2.) *Things seem to come upon them*, because the visual Spirits themselves draw back ; which makes the Object appear to come forwards : besides, when they see Things turn round, and move, Fear makes them think they are coming upon them. (3.) *The Cause that they cannot see Things afar off*, is the weakness of the Spirits ; for in every Vertigo, there is a Darkness, join'd with a semblance of turning round ; as appears also in the lighter sort of Swoonings. (4.) *The Cause of seeing Things out of their places*, is the Refraction of the visual Spirits : for the Vapour is as an unequal Medium, and gives the Sight of Things out of place, as in Water. (5.) *The Cause of seeing Things double*, is the swift Motion of the Spirits : for the Motion of the visual Spirits, and the Motion of the Object, make the same appearance ; and for the swift Motion of the Object, if a musical String be vibrated, it appears double or treble.

How Drunkenness is sooner caused, and prevented.

4. (1.) Men are sooner drunk with small Draughts, than with larger : And, (2.) Again, Wine sugar'd inebriates less than pure Wine. (1.) The Cause of the former is, that the Wine descends not so fast to the bottom of the Stomach, but stays longer in the upper Part, and sends Vapours faster to the Head ; and consequently inebriates sooner. For the same reason, Sops in Wine, quantity for quantity, inebriate more than Wine itself^v. (2.) The Cause of the second Case, is, that Sugar inspissates the Spirits, and makes

^u How is the Fact ?

^v It should also be examined, whether the Sop does not imbibe more of the Spirit of the Wine, in proportion, than of its other Parts. This is easily tried by Distillation.

makes them not so easily resolvable into Vapour *. Nay, 'tis thought some Remedy against Drunkenness, to drink sugar'd Wine after pure Wine. And the same effect is wrought, either by Oil, or Milk, taken upon hard drinking †.

DUCTILITY.

All ductile and tensile Bodies, as Metals, that will draw into Wire; and Wool and Tow, that will draw into Yarn or Thread; have a strong resistance to Discontinuity; which makes them follow the Force that draws them; without forsaking their own Body †. Viscous Bodies likewise, as Pitch, Wax, Bird lime, &c. will draw and rope. But the difference between fibrous Bodies and viscous Bodies, is plain; for all Wool, Tow, Cotton, and Silk, have, besides their Appetite of Continuance, with respect to the tenuity of their Thread, a desire of Moisture; and by Moisture to join and incorporate with other Thread, especially by means of a little wreathing. And Gold or Silver Thread, cannot be made without twisting †. See the Article HARDNESS.

DYING.

There is in some places, particularly in *Cephalenia*, a little Shrub call'd *Holly-Oak*, or *Dwarf-Oak*; upon the Leaves whereof rises a Tumour like a Blister; which they gather, and rub out of it a certain red Dust, that turns to Worms; these they kill with Wine, when they begin to quicken: and with this Dust they dye Scarlet †.

E.

ECHOES.

IN the City *Ticinum* in Italy, is a Church that hath Windows only from above. 'Tis in Length a hundred Feet, in Breadth twenty, and in Height near fifty; having a Door in the middle. It reflects the Voice twelve or thirteen Times, if you stand close by the end of the Wall, over against the Door.

V O L. III.

K

Door.

* The Operation of Sugar upon inflammable Spirits, by bare Digestion, or Solution, seems to be little consider'd. There may be a valuable Secret in it.

† These Facts may require to be better verified; but some danger attends the drinking of Milk upon Wine: especially if the Wine be tart; or any acid Humour lodge in the Stomach, as there frequently does: for it might thus produce a hard Curd in the Stomach; and prove mortal; as it appears to have done in some Instances. But the Experiment with Oil is both safer, and probably more successful. Understand the same of a Glass of Vinegar.

‡ It deserves to be observed both in the present, and all other Cases, how solicitous the Author is to express the naked Phenomena, real Appearance, or precise Natures of Things; without any help of Imagination: and let not the words Appetite, Resistance, Discontinuance, &c. be rejected, so long as they express no more than appears.

§ See the late Calculations of the Ductility of Gold, &c. by Mr. Boyle, Dr. Halley. &c.

¶ There is a Paper to this purpose in the *Philosophical Transactions*, N° 40. See also the *French Memoirs*, An. 1711. sur une nouvelle Pourpre.

Door. The Echo fades and dies by little and little, as at *Pont-Charenton* ^b. And the Voice sounds, as if it came from above the Door. If you stand at the lower end, or on either side of the Door, the Echo holds; but not if you stand at the Door, or in the middle, just opposite to it. Note, that all Echoes sound better against old Walls than new; because the old are more dry and hollow. See the Article SOUNDS.

ELECTRICITY.

*The Bodies
that are Elec-
trical.*

1. The following Bodies are Electrical^c. *Amber, Jet, Diamond, Sapphire, Opal, Amethyst, Bristol-Stone, Crystal, Clear Glass, Glass of Antimony, various metalline Fluores, Talc, Sulphur, Mastic, hard Sealing-Wax, hard Rosin, and Arsenick* ^d.

*The Bodies
that are not
Electrical.*

2. The following Bodies are not Electrical. *Emerald, Agate, Cornelian, Pearl, Jasper, Chalcedony, Alabaster, Porphyry, Coral, Marble, Touch-Stone, Blood-Stone, Emery, Ivory, Bone, Ebony, Cedar, Cypress, Pitch, soft Rosin, Camphire, Galbanum, Ammoniacum, Storax, Benjamin, Loadstone, Asphaltum.*

3. *Gold, Silver, Brass and Iron*, are not Electrical, tho ever so finely polish'd.

Sal-gem, Roch Alum, and the *Lapis Specularis*, will attract in the Winter, if the Air be sharp and clear.

*The Bodies dis-
posed to be at-
tracted.*

4. The following Bodies are apt to be attracted, if the Mass of them is small; viz. Chaff, Wood, Leaves, Stones, all the Metals, in Leaf and in Ore; Earth, Water, Oil.

*Leading Expe-
riments made
with electrical
Bodies.*

5. If a Needle be made of any Metal, and placed after the manner of the magnetick Needle, and a Lump of Amber, gently rubbed, be applied to one end thereof, the Needle will turn ^e.

6. Amber, heated before the Fire, whether to a degree of warmth, scorching, or inflammability, will not attract.

7. A red-hot Bar of Iron, Flame, a burning Candle, or an ignited Coal, being applied to light Bodies, or poised Needles, will not attract them.

8. If Amber be in a great Lump, and polish'd, it will attract, without rubbing; but if the Lump be small or dirty, it requires Friction to make it attractive.

9. Crystal, Talc, Glass, and other electrical Bodies, do not attract if burnt, or considerably heated.

10. Pitch, soft Rosin, Benjamin, Asphaltum, Camphire, Galbanum, Ammoniacum, Storax, and *Assa foetida*, have no attractive Virtue in warm Weather, but in cold a small one.

11. Moist Air blown upon Amber, or other electrical Bodies, either by the Mouth, or otherwise, stifles their attractive Virtue.

12. If

^b For an account of the Echo at *Pont-Charenton*, see the Article SOUNDS.

^c Here seem to be collected the first Elements of an Enquiry into Electricity.

^d Might not more be added to the Number? See Dr. *Plor's* Catalogue of Electrical Bodies, in the *Philosophical Transactions*, N^o 245.

^e Is this well verified?

12. If Paper, or Linen, be spread between Amber, and light, chaffy Matters, there ensues no Motion, nor Attraction.

13. Amber, and other electrical Bodies, are not excited to Attraction by receiving the Sun's Rays, as they are by Friction.

14. Amber being rubbed, and exposed to the Sun's Rays, retains its attractive Virtue the longer ; or loses it not so soon as if it had stood in the Shade.

15. Heat procured to Amber, and other electrical Bodies, by a burning Concave, does not increase their attractive Virtue.

16. Burning Sulphur, and flaming Sealing-wax, have no attractive Virtue.

17. Amber attracts best when applied to light Bodies, or poised Needles, immediately after Friction.

18. The electrical Virtue continues as strong, for a small time, as at the first.

19. Flame is not attracted by Amber, applied within the Sphere of its Activity.

20. A Drop of Water is drawn up into a Cone, upon the Application of Amber.

21. If electrical Bodies be rubbed too hard, it hinders their attracting.

22. Such electrical Bodies as scarcely attract in clear Weather, have no Virtue at all when the Air is thick and cloudy.

23. Water thrown upon Amber stifles its attractive Virtue ; tho Water itself is attracted by Amber.

24. *Sarca*^f so surrounded by Amber as to touch it, attracts ; but not at all, if the Amber be interposed without touching.

25. Oil, applied to Amber, does not hinder its Virtue ; nor destroy it tho rubbed on with the Finger.

26. Amber, Jet, and the like Bodies, have a strong electrical Virtue, and retain it long, tho excited with a small degree of Friction : but Diamond, Crystal, and Glass, must be long rubbed ; so as to grow manifestly hot, before they will attract.

27. Amber, tho near applied, will not attract such Bodies as are close to Flame.

28. Amber, and other electrical Bodies, attract the Smoke arising from an extinguished Candle : and where the Smoke rises thick and gross, the Amber attracts it strongly ; but weaker, as the Smoke ascends higher, and becomes rarer.

29. The Matters attracted by electrical Bodies, receive no manifest Alteration but in their Tendency. See the *Articles* ATTRACTION, MAGNETISM, and SYMPATHY.

K 2

EXERCISE.

^f What is *Sarca*? Was not *Sarcocolla* the thing intended?

^z It is observable, that many of the Experiments above set down, are capital or leading Experiments ; whence it appears strange, that the Enquiry has not been farther prosecuted, or driven to some solid Conclusion before this time. See Mr. Boyle, Dr. Hook, Mr. Hawksbee, Mr. Steven Gray, &c. in the *Philosophical Transactions*, &c.

EXERCISE.

Exercise of the Body. Much Motion and Exercise is good for some Bodies ; but Sitting, and less Motion, for others. If the Body be hot, and free from superfluous Moisture, too much Motion is hurtful : and 'tis an Error in Physicians, to call out so much upon Exercise ^h. Men should likewise beware how they use Exercise, and a spare Diet, at the same time : but if much Exercise, then a plentiful Diet ; and if a spare Diet, then little Exercise is best. The *Advantages* of Exercise are, (1.) that it sends Nourishment into the Parts more forcibly ; (2.) that it helps to expel by Sweat, and so makes the Parts assimilate more perfectly ; (3.) that it renders the Substance of the Body more solid and compact ; and therefore less apt to be consumed, and preyed upon by the Spirits. The *Disadvantages* of it are, (1.) that it makes the Spirits more hot and predatory ; (2.) that it absorbs, and over attenuates the Moisture of the Body ; (3.) that it makes too great a Concussion of the internal Parts, especially if it be violent ; whilst these Parts rather delight in Rest. But, in general, much Exercise is an Enemy to long Life ; which is one Reason why Women live longer than Men ; viz. because they use less Action ⁱ.

Its Advantages.

And Disadvantages.

F.

F A T.

That Flesh is convertible to Fat. N Early all Flesh may be turned into a fatty Substance, by cutting it to Pieces, and putting it into a Glass, covered with Parchment ; then letting the Glass stand six or seven Hours in boiling Water. This may be a profitable Experiment for making Fat, or Grease : but then it must be practised upon such Flesh as is not edible ; viz. that of Horses, Dogs, Bears, Foxes, Badgers, &c. ^k

F E V E R S.

The Effect of southern Winds upon Health. 'Tis noted by the Ancients, that the Southern Winds blowing much, without Rain, cause a feverish Disposition of the Year ; but not, if Rain attend them : for tho the Southern Winds may dispose the Air to breed Fevers ; yet, when Showers are joined, these refrigerate in part, and

^h Viz. Without considering the precise Cases, where it is proper, and where improper.

ⁱ Does not this short Aphorism contain the Foundation of the whole Enquiry into the Advantages and Disadvantages of Exercise to the Body ? And yet, in what Light does the Doctrine of Physicians appear upon the Subject ? *Alii aiunt, alii negant* : and the Patient is left without a Rule.

^k Has this Experiment been verified ? Or can *Flesh*, cleared of all its Membranes, and fine unctuous Skins that lie betwixt the Muscles of Animals, be converted into Fat, by so easy an Operation as that of the *Balneum Marie* ? And how far is the same, or a similar Method, practicable upon both vegetable and animal Substances ; by means of the *Digestor* ? And would not the same Instrument turn many vegetable Substances into Oil, more readily than long continued Coction ? The *Digestor* seems fitted to disclose many Secrets in Nature ; tho, at present, it appears to lie neglected.

and check the sultry Heat of the Southern Wind. And hence the Observation holds not on the Sea-coasts ; because the Vapour of the Sea refreshes, without the Assistance of Showers ¹.

F E W E L.

1. 'Tis reported, that at the Foot of a Hill near the *Dead Sea*, there is a *A Fewel that* black Stone, whereof the Pilgrims make Fires, which burns like a Coal, *consumes little,* without diminishing ; only grows brighter and whiter ^m. That this should be true, is countenanced by *Iron* ; which, when red hot, burns without consuming ⁿ : but the Strangeness is, that this Fewel should continue any time ; for *Iron*, when taken out of the Fire, grows presently dead ^o. It were a thing of great Use and Profit, to find a Fewel that would burn strong, and durably. And, perhaps, there may be such Candles as *they say* are made of Salamander's Wool ; being a kind of *Mineral*, which whitens also in the burning, and consumes not ^p. Flame must be made of somewhat, and is commonly made of a tangible Body, which hath weight ; but 'tis not impossible it should be made of *Spirit*, or *light Vapour*, in a Body ; such as the Matter of an *Ignis Fatuus* ^q : but then the Vapour can only last a short time ; tho, by the help of Oil, Wax, and other Candle-stuff, the Flame might be continued, and the Wick not burn ^r.

2. *Seacoal* lasts longer than *Charcoal* ; and *Charcoal* made of Roots, being coaled in large Pieces, lasts longer than ordinary. Turf, Peat, and Cow-sheards, are cheap Fewel, and last long ^s. Small-coal, or Briar-coal, put among *Charcoal*, makes it last longer. *Sedge* is a cheap Fewel to brew or to bake with ; and 'tis good for little else. Trial should be made of some Mixture of *Seacoal* and Earth ^t : if such Artifice be practised clandestinely, as the *Seacoal-men* use it, to increase the Bulk of the

Attempts for making a cheap Fewel.

¹ A competent Set of close Observations seems still required, to let us fully into the Cause of Fevers : how mechanically soever the Moderns may have accounted for them.

^m Is the Fact certain ?

ⁿ Does red hot Iron burn without consuming ?

^o May not two or three red hot Bars of Iron, laid a-cross, like Sticks, on a Fire, be blown by Bellows into a manifest Flame ?

^p Is not this a Preparation of the Asbestos ?

^q The Nature of the *Ignis Fatuus*, remains to be enquired into : at present, it seems chiefly used as a Term, and a help to Discourse.

^r See Mr. Boyle upon the Subject of *Phosphori*.

^s Are there not immense Quantities of a black stringy Earth, or Peat, to be found fit for Fewel, in most Counties of England ? Is not this Earth an extremely proper Fewel for Iron ? May not great Quantities of Iron-Stone, or Iron-Ore, be found adjacent to such Peat ? And is not this Peat easily changed into a better Coal, for most Purposes, than the common *Pit* or *Seacoal* ; and superior, in many Respects, to the *Turf* of Holland ?

^t Trial, is said, to have been made to advantage ; by using what they call *Sleek*, or common *Seacoal* accidentally broke, or purposely ground small, and formed with fat River Mud, into Cakes, or Balls, of a proper Size for the Fire : by which Means they obtain a cheap, durable Fewel, tho somewhat offensive by its Smoke and Smell ; almost like that of the *Dutch Turf*, or pressed Wine-Lees : which likewise make a sulphureous kind of Fewel, that burns bluish, with a disagreeable Odour. See somewhat to this general Purpose, in Mr. Boyle's *Essays upon the Usefulness of Paraphy*.

the Coal, 'tis deceit; but if used honestly, and publickly, 'tis good Husbandry'. See the *Article* FLAME.

FIRE - WORKS.

The Nature of Bitumen.

Some imagine, that *Wild-fires*, principally composed of *Bitumen*, cannot be quenched with Water, because the original Concretion of *Bitumen* is a Mixture of a fiery and watery Substance; which *Sulphur* is not. And at the Place, near *Puteoli*, which they call *Vulcan's Court*, is heard, under the Earth, a horrible Thunder of Fire and Water conflicting together: and in the same Place break out Spouts of boiling Water. Now this Place yields great Quantities of *Bitumen*; whereas *Ætna*, *Vesuvius*, and the like fiery Mountains, which consist of *Sulphur*, dart out Smoke, and Ashes, and Pumice; but no Water. 'Tis also reported, that *Bitumen* mixed with Lime, and put under Water, will make a kind of artificial Rock; the Substance grows so hard. See the *Article* GRAVITY.

FISH.

Sea Fish recommended for fresh Waters.

It appears that Fish, accustomed to salt Water, rather delight in fresh: So *Salmons* and *Smelts* affect to get into Rivers, tho it be against the Stream. At the Haven of *Constantinople* are great Quantities of Fish from the *Euxine* Sea, that, coming into the fresh Water, grow intoxicated, and turn up their Bellies; so as to be taken with the Hand. There seems not to have been sufficient Experiments made of putting *Sea Fish* into *fresh Water-Ponds*, and Pools. 'Tis a thing of great Use and Pleasure; for thus one might have them new, at a distance from the Sea: and, perhaps, the Fish will eat the pleasanter, and may breed. It is said, that *Colchester Oysters*, which are put into Pits, where the Sea goes and comes, yet, not so as to exclude fresh Water, when the Sea empties, grow by this means fatter, and fuller.

F I X A T I O N.

Fixation of Bodies.

Gold is the only Substance, that has no *volatile Parts*, yet melts with ease*. The melting shews it not jejune, or wanting in *Spirit*†; so that its fixing,

* The *Business of Jewels* is far from being advanced to Perfection. Let an Enquiry be made into the Ways of using *Cast Iron* for *Jewel*. It seems to have been little observed, that *Iron* is a *Jewel*; or capable of yielding a great degree of Heat, in proportion to the Fire that acts upon it. See Dr. George Ernest Stahl's *three hundred chemical Experiments and Observations*, printed at *Berlin*, 1731.

† The *Natural History of Bitumen*, or *Asphaltum*, seems to lie in obscurity; and its *philosophical*, or *chemical History*, is scarce touched upon. First, therefore, let the Substance be well defined and described; then chemically treated, analysed, and compared with *Naphtha*, *Petroleum*, *Camphire*, *Sulphur*, *Pitch*, *Resin*, *pitchy Coals*, and the *Caput Mortuum of Amber*, &c. See *Boerhaave's Chemistry*.

‡ Some few Trials of this kind seem to have been made of late. See Mr. Chambers's *Universal Dictionary*, under the *Article*, FISHERY, &c.

§ There are some Papers upon this Subject in the *Philosophical Transactions*, and the *French Memoirs*; but, perhaps, it has not been cultivated as it deserves.

* That is, *Gold* is a very fixed Body in the common Fires: but is it not extremely volatile in the Focus of a Burning concave?

† See the Note upon the *Article* COLOURS.

fixing is not from a Poverty of *Spirit* to fly out ; but the equal spreading, and close Coacervation of its tangible Parts : whereby the Spirits have the less Appetite, and Opportunity of escaping ^a. It were, therefore, proper to try whether Glass in melting loses weight ^b : for the Parts of Glass are evenly spread ; but not so close as in Gold. This appears from its easy Admission of Light, Heat, Cold ; and its want of Gravity. Other fix'd Bodies have little or no *Spirit* ; so that there is nothing to fly out : as in the Bone-Ashes, whereof Cupels are made ; which stand the Fire without Loss ^c. So that there are three *Causes of Fixation* ; viz. (1.) the even Diffusion of the Spirits, with the tangible Parts ; (2.) the Closeness of the tangible Parts ; and (3.) the Jejuneness, or extreme Comminution of the Spirits. The two first may be joined with a *liquifiable Nature* ; the last not ^d. See the *Articles* GOLD, GRAVITY, TRANSMUTATION, &c.

F L A M E.

1. *Flame* and *Air* do not mix, except it be in an Instant, or in the *vital* *The Commix-*
Spirits of Vegetables, and Animals ^e. The force of *Gunpowder* hath been ascribed to a Rarefaction of the earthy Substance into Flame. To examine the matter closely ; Nitre contains an extraordinary, crude, and windy *Spirit* ; which first, by the heat of the Fire, suddenly dilates itself ; and thus dilated, blowes abroad the Flame, like internal Bellows. Whence Brimstone, Pitch, Camphire, Wild-fire, and many other inflammable matters, tho they burn violently, and are hard to quench ; yet make no such *fiery Wind*, as Gun-powder does. On the other hand, Quicksilver heated, and pent in, hath the like force with Gun-powder ^f. The *vital Spirits of Animals* are a Substance compounded of an airy and flamy Matter ; and tho *Air* and *Flame*, will not well mix, when free ; yet they may when bound in by a *fixing Body*. So their *Aliments, Water* and *Oil*, do not well mix of themselves ; but in the Bodies of Plants, and living Creatures, they do ^g.
No

^a May not some of the Matter which flies off from Gold, exposed to the action of a *Burning-Glass*, be called its Spirits, or mercurial Part ; and the remaining purple Glass its jejune, spiritless, or fixed Part ?

^b By long continued melting, Glass is found to lose in weight ; and at the same time to increase proportionably in hardness.

^c Does the Matter of the Cupel sustain no diminution in Cupellation ?

^d Dr. Stahl, in his *Chemical Pieces*, has given more light to this Affair, from direct Experiment and Observation, than would be easily credited. And till his Discoveries are understood, and even carried much farther ; we shall not fully perceive the depth of the Lord Bacon's Sagacity, in driving at the *Causes of natural Things*.

^e This Subject requires an attentive Examination. The Author is intent upon it in other parts of his Works ; as, particularly, in his *History of Life and Death*. It contains perhaps one of the greatest Mysteries in all *Physicks* ; and a Secret possibly the next to that of the Union betwixt Soul and Body. But let the exactest Care be had in the Enquiry, to go no farther than Experience, Observation, close Reasoning, and, in one word, *precise Induction* carries us.

^f Is not the Force of Quicksilver confined, and endeavouring to get loose, in a strong Digestor, exposed to a violent Heat, greater than that of fired Gunpowder, weight for weight ?

^g Great part of the Mystery lies here. But is it certain, that Water is the Food of Air, or that Water is convertible into Air ; as Oil is into Flame ? The Author brings Instances to prove

No wonder therefore, that a small quantity of Spirits, in the Cells of the Brain, and Canals of the Nerves, are able to move the whole Body, with so great Force as we see in Wrestling, or Leaping; and with so great Swiftneſs, as in running Diviſions upon the Lute: ſuch is the force of Air and Flame when they incorporate ^b.

The ſecret Nature of Flame, 2. A ſmall wax Candle, being ſet in a Socket, and placed upright in a Porringer of heated Spirit of Wine; if both the Candle, and the Spirit of Wine belighted, the Flame of the Candle will open itſelf, and become four or five times bigger, than otherwiſe it wou'd have been; and appear Globular, not Pyramidal: Whilſt the inward Flame of the Candle keeps its Colour; without turning Blue, like the Flame of Spirit of Wine.

Farther open'd by an Experiment. 3. This noble Experiment ſhews two remarkable Things: The *one*, that two Flames quench not each other; but remain perfect, permanent Bodies; as Air, or Water. And therefore Flame wou'd ſtill aſcend upwards in the ſame Magnitude, if not quenched on the ſides; and the greater the Flame is at the bottom, the higher it riſes ⁱ. The *other* Thing is, that Flame doth not mix with Flame, as Air with Air, or Water with Water; but only remains Contiguous; as in conſiſtent Bodies. Hence alſo the pyramidal Form of Flame is merely accidental; as the ſurrounding Air, by quenching the ſides of the Flame, ſqueezes it into that Form; for of itſelf it wou'd be round: and, therefore, Smoak riſes in the Figure of an *inverted Pyramid*; for the Air quenches Flame, but receives Smoak. Note, alſo, that the Flame of a Candle, within the Flame of the Spirit of Wine, is diſturbed; and doth not only open and move upwards, but wave to and fro: as if Flame, of its own Nature, were it not quenched, wou'd roll and turn, as well as move upwards. By all which it ſhou'd ſeem, that the *fixed Stars are true Fires or Flames*, as the *Stoicks* held; finer perhaps, and more rarified; than our Flame is. For, (1.) they are Globular and Determinate; (2.) they have Rotation; and (3.) they have the Colour and Splendor of Flame: ſo that *Flame* above ſeems durable, conſiſtent, and in its natural place; but with us a Stranger, momentary, and impure; like *Vulcan* halting with his Fall ^k.

4. Hold

prove it in his *Hiſtory of Winds*; but the Doctrines is not, perhaps, ſo firmly and clearly eſta- bliſhed, as it requires. The Experiments of Mr. Boyle are rather conſtrued againſt; but has not Sir *Iſaac Newton* given conſiderable Light to this Matter, in his *Queries*?

^b Conſult Mr. Boyle, and farther Experience upon the Subject.

ⁱ Obſerve the Method of arguing from Experiments by Induction; according to the Laws of the *Novum Organum*: but remember, that all is ſubmitted to *Veriſication*, and the *Proof of Axioms*.

^k Here we have an Inſtance of the capital Uſe of Leading Experiments; the Advantage of the Rules of *Philophizing*, lately laid down by Sir *Iſaac Newton*; and the ſurprizing Lengths whereto obvious Experiments may reach, in diſcloſing the Works of Nature. In ſhort, almoſt every new Experiment that is made, may be a means of opening a new Scene in Nature; eſpecially when exactly verified, and extended by *Induction*; or according to Sir *Iſaac Newton's Regule Philoſophandi*. See more to this purpoſe in Dr. Pemberton's *Introduction to his View of Sir Iſaac Newton's Philoſophy*.

4. Hold an Arrow in Flame, for ten Seconds; and the Parts on the outside will appear more burnt, black, and turned almost to a Coal, whilst those in the middle will appear as if the Fire had scarce touched them. This is an *Instance* of Consequence, for discovering the nature of Flame; and shews that Flame burns more violently towards the sides, than in the middle¹; and that Heat, or Fire, is not violent or furious, but where checked and restrain'd. Whence the *Peripateticks* seem properly to answer the Objection, that if a Sphere of Fire encompass the Earth, all Things would be burnt up; by alledging, that pure *elementary Fire*, in its own place, and not irritated, has but a moderate Heat^m.

5. The Continuance of Flame, according to the difference of the Body inflamed, and other Circumstances, is worthy the Enquiry; chiefly because Flame tho almost momentary, yet receives degrees of more, and less. A Spoonful of *Spirit of Wine*, a little heated, burnt for a hundred and sixteen Seconds. The same quantity, mixed with the sixth part of a Spoonful of Nitre, burnt but ninety-four Seconds. Mix'd with the like quantity of Bay-Salt, eighty three Seconds. Mix'd with the like quantity of Gun-powder, which dissolved into a black Waterⁿ, a hundred and ten Seconds. A Cube of yellow Wax, equal to half the *Spirit of Wine*, set in the midst, burnt only the space of eighty-seven Seconds. Mix'd with the sixth part of a Spoonful of Milk, it burnt a hundred Seconds; and the Milk was curdled. Mix'd with the sixth part of a Spoonful of Water, it burnt eighty-six Seconds; and with an equal quantity of Water, only four Seconds. A small Pebble was laid in the midst, and the Spirit of Wine burnt ninety-four Seconds. A piece of Wood, the bigness of an Arrow, and about a Finger's length, being set up in the midst, the Spirit of Wine burnt ninety-four Seconds. So that the *Spirit of Wine* simple, endured the longest; and the Spirit of Wine with Bay-Salt, and the equal quantity of Water, the shortest time.

6. Note, that in the *Experiment of Wax*, the Wax dissolved in the burning, tho without incorporating with the *Spirit of Wine*, so as to produce one Flame; but where the Wax floated, the Flame forsook it; till at last it spread all over, and put the Flame quite out. Consider, whether the more speedy extinction of the Flame be caused by its great Vigour in burning; or by the Resistance of the additional Body, and the Aversion thereof to take Flame: which will appear by the quantity of the *Spirit of Wine*, that remains after the Flame goes out. It seems to be the latter; be-

V o L. III.

L

cause

¹ This Observation is prosecuted by Dr. Hook, in order to shew the Nature of Fire and Flame.

^m It were proper to collect the several Instances that shew the weak effects of Flame, in the internal, and its Strength on the external Parts; as in firing of Brandy on the Finger; the burning of inflammable Spirits on Linen, without singeing; the burning of Oil without touching the Wick, &c. See Mr. Boyle, Dr. Hook, Dr. Stahl, &c. and M. Homberg on Phosphorus, &c. See also the Chapter of Fire, in Boerhaave's Chemistry.

ⁿ Hence it is evident, that the Spirit of Wine was not high rectified; and therefore these Experiments can by no means be depended upon, for Precision or Exactness; but shou'd be repeated with perfectly dephlegm'd Spirit.

cause the Mixture of the Things least apt to burn, goes out the soonest. And Note, by the way, that *Spirit of Wine* burnt, till it goes out of itself, will burn no more ; and tastes not so hot in the Mouth as it did ; nor yet sour, as burnt Wine does ; but flat and dead °.

Experiments
relating to the
duration of
Candles, differ-
ently prepa-
red.

7. Pure Wax, made into a Candle, and Wax mix'd into Candle-stuff, (1.) with Water, (2.) Spirit, (3.) Milk, (4.) Bay-Salt, (5.) Oil, (6.) Butter, (7.) Nitre, (8.) Brimstone, and (9.) Saw-dust, severally ; in the proportion of a sixth part to the Wax ; and made into Candles of the same Weight and Wieck with that of Wax, burnt thus. That with *Saw-dust* consumed the fastest ; but burnt fair till some part of the Candle was wasted ; and the Dust gathered about the Snuff, which then grew big, long, and burnt dimly ; and the Candle wasted in half the time of the pure Wax. The *Candles with Oil and Butter* consumed a fifth part sooner than the pure Wax. Next, burnt out the *Candle of pure Wax itself* : Then that with *Bay-Salt* ; which lasted about an eighth longer than the Wax. Next followed that with *Spirit* ; which lasted about a fifth part longer than the Wax. Then followed those with *Milk* and *Water*, with little difference ; only that with *Water* consumed the slowest. And in these four last, the Wieck spit forth little Sparks. That with *Nitre* would not keep lighted above twelve Seconds ; and all the while spit out portions of Flame ; which afterwards turn'd to Vapour. The Candle with *Brimstone* kept lighted much like to that with *Nitre* ; but, in a short time, it hardned, and caked about the Snuff : so that the *mixture of Bay-Salt with Wax*, gains an eighth part ; and that with *Water* a fifth, in point of Duration[¶].

Experiments
for rendring
Lights durable,
by ordering
the Wieck.

8. Trial was made with different *Wiecks* ; viz. (1.) of ordinary Cotton, (2.) Sewing Thread, (3.) Rush, (4.) Silk, (5.) Straw, and (6.) Wood. The *Silk*, *Straw*, and *Wood* flamed a little, till they came to the Wax, and then went out ; the *Thread* consumed faster than the *Cotton* by a sixth Part ; next consumed the *Cotton* ; and the *Rush* consumed slower than the *Cotton*, by at least a Third. The *Cotton* and *Thread* gave a Flame much alike ; but the *Rush* much less, and dimmer[¶].

(2.)
By hardning
the unfluious
Matter.

9. Good House-wives, to make their Candles burn the longer, lay them, one by one, in Bran, or Flower ; which rendring them harder, they thus consume the slower : insomuch as to burn twice as long as Candles of the same sort, not so treated. For Bran and Flower have a power to harden ; so that both Age, and lying in the Bran, conduces to their lasting. And Wax Can-
dles

° It is sufficiently known that *high rectified Spirit of Wine* burns dry, without leaving the least Moisture behind ; and that this Spirit is a thing immensely different from Wine. The *Essay* I published upon *inflammable Spirits*, may give some farther Light in this matter.

¶ To determine the best and cheapest Materials for Candle-stuff, may require some Attention, and a variety of Experiments. Wax is an excellent substance for the purpose ; were it but near so cheap with us as in the *East-Indies* : whence it might deserve a particular Enquiry, how to render it cheaper in *Europe*, and with what Substitutes, we are in this Case provided. See the *Articles FAT, FEWEL, and FIRE-WORKS*.

¶ It is no bad Expedient, which the poor People have in some Parts of *England*, to dip Rushes in their melted Kitchen-stuff, or common Train-Oil, and burn them about the House, instead of Candles. The *Wax-cloth*, which comes by way of Wrapper, from the *East-Indies*, is much neater ; and makes an agreeable Taper.

dles burn longer than Tallow ones ; because Wax is more firm and hard than Tallow^r.

10. The *Duration of Flame* also depends upon the easy supply of the Nourishment : Thus, in the *Court of England*, there is a *Service*, they call *All-Night*^t ; being a kind of a great Cake of Wax, with a Wieck in the middle ; which thus derives its supply at a distance^u. So Lamps also last the longer ; because their Vessel is much broader than a Taper or Candle.

11. Take a Turret-Lamp of Tin, made square ; the height of the Turret being thrice that of the lower part, whereon the Lamp stands : make only one Hole in it, at the end of the Return furthest from the Turret : reverse it, and fill it full of Oil by that Hole ; then set it upright ; put a Wieck in at the Hole ; light it : and it will burn slow and long ; because here also the Flame derives its Nourishment afar off^v. And as the Oil wastes and descends, so the top of the Turret gradually fills with Air ; from the Rarefaction of the Oil by Heat. It were proper to make a Hole in the top of the Turret, and try when the Oil is almost consumed, whether the Air generated by the Oil will enflame, if a Candle be applied to it, in letting of it out^w. It were proper also to have the Lamp made, not of Tin, but of Glass ; to shew how the Vapour, or Air, gathers by degrees in the top^x.

12. Another thing conducing to the duration of the Flame, is the Closeness of the Air, wherein the Flame burns. The Wind blowing upon the Candle wastes it apace. Hence a Candle lasts longer in a Lanthorn than at Large. And *there are Traditions* of Lamps and Candles, that have burnt a very long time in Caves and Tombs^y.

13. The last particular, to the same purpose, is the *Nature of the Air*, wherein the Flame burns ; whether it be hot or cold, moist or dry. The Air, if very cold, irritates the Flame, and makes it burn more fiercely ; and so forwards the Consumption. The Air once heated, makes the Flame

L 2

burn

^r If Hardness be a principal Reason why Wax burns more durably than Tallow ; cou'd not a way be found, to render Tallow nearly as hard as Wax ?

^t I suppose from its burning all Night, without any fresh Supply.

^u For the Construction of Lamps, see Dr. Hook's LAMPAS ; and Mr. Boyle's Contrivance of a Lamp, in the *Philosophical Transactions*.

^v How is the supply of a Lamp render'd easier, by deriving its Fuel from a considerable distance ? Or what is the best Distance to be observed betwixt the Fuel and the Flame ?

^w There is a curious Discovery intimated in this Direction, which few seem to have attended to ; except Dr. Stahl. See his *Experimenta, Observationes, & Animadversiones*, 300 numero.

^x There are some very late Applications of Glass Vessels for Lamps. Consider the nature of the *Convex Lamp* : and try to improve the common Structure. See Dr. Hook's *Lampas*.

^y What degree of Truth is found in these Relations ? or what the precise Matter of Fact ? See the Writers upon Antiquities ; and the Chemical Philosophers, upon the Subject of *Phosphori*, particularly Mr. Boyle.

burn milder ; and so promotes its Continuance. The Air, if dry, is indifferent ; and, if moist, it quenches the Flame, in some degree, (for Lights go out in the Damps of Mines,) or makes it burn more dully, and so prolongs its duration ^r.

† The rise of
Water
by means of
Flame.

14. Set a lighted Candle at the bottom of a Bason of Water, and turn the mouth of a Glass over the Candle ; and the Water will rise into the Glass. For the Flame of the Candle, when cover'd, being suffocated by the close Air, lessens by degrees ; during which time there is some little gradual ascent of Water. But upon the Instant the Candle goes out, there is a sudden rise of a great deal of Water ; the body of the Flame now filling no more space, so that the Air and the Water succeed ^z. The effect is the same, if, instead of Water, Flower or Sand be put into the Bason ^a.

F L E S H.

Of eatable and
uneatable
Flesh ; in
Beasts.

1. Of Flesh, some is edible, and some not ; except in Famine ; as having commonly too much bitterness of Taste : and therefore cholerick Creatures, are not eatable ; such as *Lions, Wolves, Squirrels, Dogs, Foxes, Horses, &c.* ^b But *Kine, Sheep, Goats, Deer, Swine, Rabbits, Hares, &c.* are mild and fearful Creatures. Yet *Horses*, which are Beasts of Courage, we find are eat by some Nations : whence the *Scythians* were call'd HORSE-EATERS ; and the *Chinese* eat Horse-flesh at this Day ; and some Epicures have eat Colt's-flesh baked.

Birds.

2. Among *Birds*, the Carnivorous, and *Birds of Prey*, are commonly not good to eat. The reason is rather the cholerick Nature of such Birds ^b, than their feeding upon Flesh ; for *Pewets, Gulls, Ducks, &c.* which feed upon Flesh, are good Meat, when very young. And those Birds of Prey that feed upon Flesh, as *Hawks, Rooks, Owls, &c.* are tolerable Food.

And Men.

3. Man's Flesh is not eaten ; (1.) because Men, in Humanity, abhor it ^c. (2.) Because no living Creature that dies of itself, is good to eat : whence the *Canibals* eat only the Flesh of the slain. And (3.) because there must generally be some Disparity between the Nourishment, and the Body nourished ^c : yet we see, in great Weaknesses and Consumptions, Men have been sustained with Woman's Milk. 'Tis said, that Witches greedily devour Man's Flesh ^d ; which, if true, may proceed, from hence, that human

^r This Subject requires a farther Experimental Enquiry into the Nature of Fire and Flame. The three hundred *Experiments and Observations* of Dr. Stahl, mentioned above, have a particular Tendency this way.

^z May not some very considerable Discoveries be derived from this Experiment ? And does not the late noble *Fire Engine*, for raising Water, depend upon this Power ?

^a Which may in some measure shew, that such powdery Bodies approach to the Nature of Fluids.

^b Have these Creatures a greater quantity of Bile, in proportion, mixed with their Blood, than others ?

^c This is farther explained in the *Author's History of Life and Death*.

^d What Truth is there in that Report of the fine Taste of human Flesh ; for which it is said to be coveted by some *Americans* ? And by what means was the eating of Man's Flesh introduced in that Country ; whilst it is so detested by other Nations ? Was this thro' Choice, or Necessity ?

human Flesh sends up high and pleasing Vapours, which stir the Imagination; for the *Felicity of Witches is chiefly in Imaginatism*. See the *Articles* FOODS and POISONS.

FLYING.

'Tis anciently reported of the *Leucadians*, that out of Superstition, they ^{Of flying in the Air.} used to precipitate a Man from a high Cliff into the Sea; first tying about him many large Fowls; and fixing to his Body various Feathers, expanded, to break the Fall. And doubtless Birds of a good Wing, might fly loaded with a considerable Weight: and Feathers spread broad and close, will likewise buoy up a great Weight. The farther Application of this Experiment for flying, may be thought upon*. See the *Article* GRAVITY.

FOODS.

1. Some *Foods* may be used long, and in quantity, without cloying; as Bread, lean Flesh, &c. others, tho pleasant, glut sooner; as Sweet meats, fat Things, &c. The *Cause* is, that Appetite consists in emptiness of the Stomach; or its upper Orifice being possessed with somewhat that is astringent, and therefore cold and dry. But Things sweet and fat are more filling, and float and hang more about the Mouth of the Stomach; and go not down so speedily: and again turn sooner to Bile; which is hot, and always allays the Appetite^f.

The Causes of Appetite and Satiety, viz.

2. Another *Cause of Satiety*, is too great Custom; and the Appetite of Novelty: whence the same Meats continually taken, induce loathing. To assign the reason for the Disgust of Satiety; and of the Pleasure of Novelty; and to distinguish, not only in Meats and Drinks, but also in Motions, Love, Company, Delights, Studies, which they are that Custom makes more grateful, and which more irksome, were a large Field. But for Meats, the *Cause is Attraction*; which is quicker, and keener towards new Things, than towards such as have left a Relish by former Use. And generally 'tis a Rule, that whatever is a little ungrateful at first, is rendered grateful by Custom; but whatever is too pleasing at first, quickly turns to Satiety.

3. *Vegetables* have some Parts more nourishing than others: thus *Grain* ^{What Meats afford most Nourishment.} and *Roots* nourish more than *Leaves*; inasmuch that the *Order* of the *Folietani* was put down by the *Pope*, upon finding *Leaves* unable to nourish the Body^g. Whether there be that difference in the Flesh of living Creatures, is not yet well known: as whether *Livers*, and other *Entrails*, be not more nourishing than the outward Flesh. We find that amongst the *Romans* a Goose's Liver was a great Delicacy; whence they had artificial Means

* See Bishop Wilkins's *Dedalus*; and consider the Expedients of *Friar Bacon*, and some later mechanical Writers for this purpose.

^f Is there not somewhat deeper in this Affair, depending chiefly upon the Juices, or what may properly be called the *Menstruums* of the Stomach? See the *Article* CONCOCTION.

^g What were the particular Rules to which this *Order* obliged themselves? Were they restrained to feed on the Leaves of Trees only? For there seems to be considerable Nourishment in boiled Lettice, Cabbage, and other Plants of a large and tender Leaf.

Means to make it fair and large ; but whether it were more nourishing, does not appear^z. It seems certain, that *Marrow* is more nourishing than Fat. And, I conceive, that a Decoction of Bones and Sinews, stamped, and well strained, wou'd make a very nourishing Broth^h. We find also that *Scotch Skinck*, a Pottage of strong Nourishment, is made with the skins and sinews of Beef, long boil'd. *Jelly* likewise, is chiefly made of knuckles of Veal. The Pulp within the Craw-fish, or Crab, is more nourishing than the Flesh. The Yolks of Eggs are more nourishing than the Whites. Whence it shou'd seem that the Parts of living Creatures which lie more inward, may nourish better than the outward Fleshⁱ. And for the nourishing of aged Men, or Persons in Consumptions, some such Thing might be devised, as should be half *Chyle*, before it comes into the Stomach^k.

An Experiment for making a nutritive Drink.

4. For Example ; Parboil two large Capons, upon a soft Fire, for an Hour, till the Blood disappear in that form. Add, in the Decoction, the peel of a sweet Lemmon, or Citron, and a little Mace. Throw away the Shanks, and mince the two Capons, Bones and all ; and put them into a large Boulter. Then take a sweet, and well-season'd Kilderkin, containing four Gallons of eight Shilling Beer, new as it comes from the Tun ; make a large Bung-hole in the Kilderkin, at which thrust in the Boulter, with the Capons : let it steep, and work three Days and Nights, with the Bung-hole open ; then close the Vessel : and so let it continue a day and a half. Now draw it into Bottles ; and drink it after three Days standing. It will keep six Weeks, drink fresh, and flower and mantle exceedingly ; but taste not newish at all. It is an excellent Drink for a Consumption ; to be used either alone, or mixed with other Beer. It quenches Thirst ; and has nothing of Windiness. Note, it is impossible, that Meat and Bread, either in Broths, or taken with Drink, shou'd get into the Veins, and external Parts, so fine, and with so much ease, as when thus incorporated, and made almost *Chyle* beforehand^l.

Farther Trials recommended with Roots and Flesh.

5. Trial of the like kind might also be made with Potatoes, *Bur-Roots*, and *Artichook* Bottoms ; which are nourishing Meats : and with other Flesh ; as *Pheasant*, *Partridge*, *Pig*, *Venison*, but especially that of Fawns, &c.

Capons and Almonds.

6. A Mortrefs or Soop, may be made of the Flesh of Capons, stamped, strain'd, and mix'd with an equal quantity of *Almond-Butter*^m. This is an excellent Mefs, for nourishing those that are weak ; and better than Jellies.

So

^z Has any considerable Light been given to this Affair, by the modern Enquirers ?

^h 'Tis found so by means of the DIGESTOR. See the *Author's NEW ATLANTIS*.

ⁱ No safe Induction can be made from a few *Instances* ; especially such as are not *Capital* : Let the *Enquiry* therefore be farther continued.

^k See the *NEW ATLANTIS*.

^l The Author here speaks from Experience : and certainly the Receipt is well calculated, and deserves to be tried ; especially in Consumptive Habits ; or worn out Constitutions ; and Persons grown weak and feeble with Age.

^m What the Author here means by *Almond-Butter* ; is, perhaps, no more than a rich Emulsion of blanched Almonds, rather than a direct unctuous Substance.

So is the Cullis of Cocks, boil'd thick, with the like mixture of Almond-Butter: for the Cullis, or Soop, of itself, is more savoury and strong, and not so fit to nourish weak Bodies; but the Almonds, that are not of so high a taste as Flesh, serve to qualify it.

7. *Indian Maiz* has an excellent Spirit of Nourishment; but it must be thorowly boil'd, and made into a *Maiz-Cream*, like *Barly-Cream*. I judge the same of *Rice*, made into a Cream; for *Rice* is a principal Food in *Turkey*, and other Eastern Countries: but it must be thorowly boiled, on account of its hardness; and because, otherwise, it binds the Body too much.

8. *Pistaches*, if good, and not musty, join'd with Almond-Milk, or *Pistaches*, made into a Milk of themselves, which is like Almond-Milk, tho greener; are an excellent Nourishment: but 'tis proper to add a little Ginger, because they are not without some subtile Windiness.

9. *Milk*, warm from the Cow, is found a great Nourisher; and a good Remedy in Consumptions: but as it is milking, there should be put into it two little Bags; the one of *Powder of Mint*, the other of *Powder of Red-Roses*; for these keep the Milk, in some degree, from turning, or curdling in the Stomach. Put in Sugar also, for the same Reason, and partly for the Taste's sake. But a large Draught shou'd be taken at once; that it may stay the less time in the Stomach, and so not curdle. And let the Cup into which it is milked, be set in a large Vessel of hot Water; that it may be had warm. *Cow's Milk*, thus treated, I judge better for a Consumption than *Asses Milk*; which indeed turns not so easily, but is a little harsh. *Cow's Milk* is doubtless more proper for Sharpness of Urine, Exulcerations of the Bladder, and all Intentions where Lenifying is required. Womens Milk likewise is prescribed, when all others fail; but I commend it not, as approaching a little too near the Juices of the Body, to be very nourishing; except in Children, to whom 'tis natural.

10. *Oil of sweet Almonds*, newly drawn, and mix'd with Sugar, a little Spice, and spread upon toasted Bread, is an excellent Nourisher; but then to keep the Oil from frying in the Stomach, a large draught of mild Beer should be taken after it: and to prevent its relaxing the Stomach too much, use a little Cinnamon-Powder.

II. The

* The Preparations of this kind seem in a manner neglected by Physicians and Apothecaries; and are turn'd over to the Women: tho as capable, perhaps, of proving serviceable in certain Distempers, as some Remedies now in use.

° What say the Physicians, and Men of Experience, to this? Their Practice runs the contrary way: but upon what foundation of Reason and Certainty? *Asses Milk* is said to be thinner, and therefore imagined capable of passing the finer Vessels, where thicker Milk would be excluded. But is this any other than a Conjecture? And cou'd not *Cows Milk* be properly diluted to an equal tenuity with *Asses Milk*? The Difference must be determin'd by a sufficient number of competent Experiments; as well of the *Physical* and *Chemical*, as *Medicinal* kind.

° See this Subject farther prosecuted in the *Author's History of Life and Death*.

Eggs.

11. The Yolks of Eggs are so well prepared by Nature for Nourishment, as to require nothing more than Poaching, or soft Boiling; tho they may be taken raw, when new laid, along with Malmsey, or sweet Wine; whereto may properly be added, a few Slices of *Eryngo Root*, and a little Ambergreese: by which means, besides the immediate Faculty of Nourishing, such Drinks will be made corroborative; and not expel too fast by Urine: for too plentiful a Discharge by Urine, hinders Nourishment.

The Mincing
of Meat.

12. *Mincing of Meat* saves the Grinding of the Teeth; and therefore contributes to Nourishment, especially in Age; or where the Teeth are weak: but Butter is not so proper for weak Bodies: it were therefore expedient to moisten the minced Meat with Claret and Sugar, lightly aromatized with Cinnamon or Nutmeg.

The several
Means of con-
verting, or as-
similating the
Nourishment;
viz. (1.) Pre-
venting its go-
ing off by U-
rine, and
Sweat.

13. There are several Means of converting the Nourishment to its right Use: the first is, to procure that it be not diverted, or drawn away; or, to provide, that the Kidneys attract not an over-Propotion of the Blood into Urine. To this add Aristotle's Precept; that Wine be avoided in all Consumptions: because the Spirit of Wine preys upon the roscid Juice of the Body, and robs the animal Spirits of their Nourishment. Therefore, if the Consumption proceed from the Weakness of the Stomach, enforce the Use of Wine; but let it alway be burnt, that the more subtile Spirits may evaporate[†]. Add also, that too great Waste of the Nourishment be prevented, by Exhalation and Sweat: so that, if the Patient be apt to sweat, this must be gently restrained. But chiefly, Hippocrates's Rule is to be followed; who advises quite contrary to what is in use: viz. that the Cloathing next the Skin, be, in Winter, dry, and often changed; but, in Summer, seldom changed, and smeared over with Oil: for certainly, any Substance that is fat, somewhat fills up the Pores of the Body, and prevents Sweat: but the more cleanly way is, to have the Linen smeared lightly over with Oil of sweet Almonds; and to shift as often as is proper.

(2.)
By strengthen-
ing the Sto-
mach.

14. The second Means is, to send the Nourishment more forcibly into the Parts, by strengthening the Stomach; and, as the Stomach is chiefly comforted by Wine, and hot things, which are otherwise prejudicial, 'tis proper to use external Applications to the Stomach: but it has been found, that the Quilts of Roses, Spices, Mastich, Wormwood, Mint, &c. are not so serviceable as a Cake of new Bread, sprinkled with Sack, or Alicant; then dried a little before the Fire, wrapt in a clean Napkin, and laid to the Stomach: for all Meal has a great Power of Astringion; so as to harden Flesh, or Flowers, laid in it: whence, also, a Bag, quilted with Bran, is very serviceable; tho it dries too much, and therefore should not lie on too long.

(3.)
By indulging
Sleep.

15. The third Means is, to distribute the Nourishment better by Sleep: for Bears, and other Creatures that sleep in Winter, grow exceeding fat: and, indeed, Sleep greatly nourishes the Spirits; not only because the Nourishment is less spent in Sleep; but it also helps to propel the nutritive Matter

[†] This may deservedly appear an useful Caution.

ter into the Parts. Therefore, in aged Men, weak Bodies, and such as abound not with Bile, a short Sleep after dinner contributes to nourish : for in such Bodies there is no fear of an over-hasty Digestion ; which is the Inconvenience of Afternoon-sleeps. Sleep also in the Morning, after taking somewhat of easy Digestion ; as Milk from the Cow, nourishing Broths, or the like ; promotes Nutrition : but this should be done sitting upright ; that the Fluid may pass the more speedily to the bottom of the Stomach.

16. The fourth Means is, to provide that the Parts themselves may attract the Nourishment strongly. Aristotle excellently observes, that a great reason why some Plants survive living Creatures, is because they yearly put forth new Leaves, and Boughs ; whereas, living Creatures, after their period of Growth, put forth nothing that is young, but Hair and Nails ; which are Excrements, and no Parts. And it is certain, that whatsoever is young draws Nourishment better than what is old : but the Pith of the Observation is this, that the young Boughs, and Leaves, drawing the Sap up to them, the Sap thus nourishes the Body in its Passage. This we find remarkably illustrated in the frequent Cutting, or Trimming of Hedges, Trees, and Herbs ; which conduces much to their Duration. The Observation should, therefore, be transferred to the promoting of Nutrition in living Creatures : the noblest and principal Use whereof is, for the Prolongation of Life ; the Restoration of Youth, in some degree ; and mollifying of the Parts of the Body. For there are some Parts in Animals, that are easily nourished and repaired ; but others, with greater Difficulty : and the Point of View is, to renew such as are easy to nourish, that the others also may be refreshed ; and, as it were, made to imbibe Nourishment in the Passage. Draught-Oxen, put into good Pasture, recover the Flesh of young Beef ; and Men, after long emaciating Diets, grow plump, fat, and almost new Creatures : so that we may conclude, the frequent and prudent Use of emaciating Diets, Purgings, and, perhaps, some kinds of Bleeding, to be a principal Means of prolonging Life, and restoring some degree of Youth : for Death comes upon living Creatures, like the Torment of Mezentius ; whilst the more reparable Parts of the Body, as the Spirits, Blood, and Flesh, die in the Embraces of the Parts less reparable ; as the Bones, Tendons, and Membranes. The same Observation may be applied to the nourishing of emaciated Bodies : and therefore gentle Friction draws on Nourishment, by heating, and making the Parts a little hungry. This Friction should be used in the Morning. It is also best done by the Hand, or a Piece of scarlet Wool, moistned with Oil of Almonds, that is mixed with a little Bay-salt, or Saffron. The Currying of Horses conduces to make them fat, and sleek.

17. The fifth Means of converting the Nourishment to its proper Use, is, to promote the Act of Assimilation ; which is done by some outward Emollients, that

(4.)

By promoting Attraction in the Body.

(5.)

Promoting the Act of Assimilation.

V O L. III.

M

‘ This whole Affair is more largely prosecuted in the Author’s History of Life and Death ; whereof the Doctrine here delivered, may be construed the Basis : and serve as an eminent Instance of the Design and Use intended to be made of the whole Sylva Sylvarum, in furnishing the Matter for numerous particular Histories.

that make the Parts more apt to assimilate. For this purpose I have a compound Ointment, of an excellent odour ; which, I call *Roman Ointment*. It is to be used between Sleeps ; for it is in the latter Sleep, that the Parts chiefly assimilate. The *Ointment* is prepared as follows :

18. *UNGUENTUM FRAGRANS, SIVE ROMANUM*:

The Sweet, or, Roman Unguent.

*The Author's
Roman Un-
guent.*

Take of *Deer's Suet*, four Ounces ; *Oil of sweet Almonds*, two Ounces : set them upon a very gentle Fire ; and stir them till they are melted. Add *Orrice Root*, and *Damask Roses*, powdered, together, two Drams ; of *Myrrh*, a Dram ; of *Cloves*, a Scruple ; of *Civet*, eight Grains ; of *Musk*, twelve Grains ; of *expressed Oil of Mace*, two Drops ; and as much *Rose-Water* as suffices to keep the Unguent thin. Let all these be put together in a Glass ; and set upon hot Embers, for the Space of an Hour, and stirred well with a Juniper Stick. See the *Articles* FRICTIONS, HUNGER, and NOURISHMENT.

F R A G I L I T Y.

*The Cause of
Fragility and
Toughness.*

Some Bodies are fragile, and others tough : some fragile Bodies break only where the Force is applied ; some shatter into many Pieces. The *Cause* of Fragility is an Impotency to be extended^u : whence Stone is more fragile than Metal ; and so, *fiatile Earth* is more fragile than *crude Earth* ; and dry Wood, than green. The *Cause* of this Unaptness to Extension, is a Deficiency of Spirits ; for 'tis the *Spirit* that promotes the Extension of Bodies : and this Indisposition is ever concomitant with Porosity, and Dryness in the tangible Parts. Tough Bodies have more Spirits, fewer Pores, and moister tangible Parts : whence Parchment, or Leather, will stretch ; but Paper, not : and woollen Cloth will tenter ; but linen hardly^x.

F R I C T I O N S.

*The Advan-
tage of Fric-
tions over Ex-
ercise.*

Friction makes the Parts more full and fleshy ; as appears not only in Men, but in the Currying of Horses, &c. because it draws a greater Quantity of Spirits, and Blood, to the Parts ; and also attracts the Aliment more forcibly from within : again, because it relaxes the Pores ; and so makes better way for the Spirits, Blood, and Aliment : and lastly, because it dissipates and digests any useless or excrementitious Moisture, that lies in the Flesh : all which conspire to promote Assimilation. Frictions also fill up, and fatten the Body, more than Exercise ; because, in Frictions, the inward
Parts

^u 'Tis great pity, that the preceding *Doctrine* should not have been better observed, and cultivated, by Physicians. To a Neglect in this Matter, the Imperfection we daily experience in Medicine, may be, in a good measure, attributed.

^v This *Unguent* requires some Skill, to prepare it in the manner directed.

^u This seems a convertible Term, rather than a Cause ; but the Cause is closer attempted by what follows.

^x See more to this purpose in Mr. Boyle's *Enquiry into the Origin of Forms in Bodies* ; Dr. Clarke's *Notes upon Robault's Physicks* ; and the Writers upon *Metallurgy*.

Parts are at rest ; which, in Exercise, are often hurt and bruised too much ^v. See the *Article* EXERCISE.

FROST.

In the cold Countries, if the Extremities of the Body be frozen and mortified, and the Person approaches a Fire, the Parts affected presently rot off ; because the few Spirits remaining in those Parts, are thus suddenly drawn out : and thence Putrefaction is completed. But Snow applied, does good ; as preserving those Spirits that remain, till they can revive : besides, Snow may have a *secret Warmth* ^z. Warm Water also proves serviceable ; because it opens the Pores by degrees, without working suddenly upon the Spirits. This Experiment may be transferred to the *Cure of Gangrenes* : but here, beware of a dry Heat ; and use things that are Cooling, with an inward Warmth and Virtue of Cherishing¹. See the *Articles* PUTREFACTION, and TRANSMUTATION.

FRUIT.

1. To produce *Fruit without Cores, or Stones*, requires abundance of Moisture ; for the *Core, and Stone*, are made of a dry Sap : and we see, 'tis possible to make a Tree yield only Blossoms, without Fruit ; as, in Cherries, with double Flowers : much more Fruit, without Stone or Core^b. 'Tis reported, that the Cion of an Apple-Tree, grafted upon a Colewort-stalk, yields a large Apple, without a Core. 'Tis not improbable, if the inner Pith of a Tree were taken out, so that the Juice may rise only by the Bark, this might work the Effect : for it has been observed, in Pollards, that if the Water get in at the Top, and they become hollow, they put forth the more. It is also delivered for certain, that if a Cion be grafted the small end downwards ; it will make the Fruit have little or no Core, or Stone^c. See the *Articles* VEGETABLES, and VEGETATION.

M 2

2. Fruits

^v This is a very material Distinction ; and should be well regarded in Practice : thus, for example, Exercise in the Case of unsound Viscera, might prove highly prejudicial ; whilst Friction might have all the good Effects, proposed by Exercise, without any danger.

^z That Snow may have a secret Warmth, seems countenanced by certain Phenomena and Observations ; as making the Hands glow ; preserving Corn in the Ground, &c. See Mr. Boyle's *experimental History of Cold*.

^a It is observable, that the true Causes of Gangrenes, Mortifications, Corruptions, and all the Changes leading up to them ; as Digestion, Chylification, Sanguification, beginning Putrefaction, the Generation of Pus, Ichor, and all the morbidick Humours ; are very little enquired into : Whence no wonder, if Medicine and Chirurgery remain imperfect. If it might give any Light to this Affair, we would venture to ask, *whether the Body has not a Chemistry peculiar to itself ; whereby all these Operations are silently brought about ?* And, before the Answer is returned, let the Matter be well considered, and examined ; at least, in some one capital Change ; as that of the *Aliment into Chyle* ; that of the Chyle into Blood ; that of the Blood into specified Juices ; and that of any of the Juices, or Blood itself, into Pus, &c.

^b Let the Use of *Instances of Approach* be remembered here ; and upon all the like Occasions. See the *Novum Organum, Part II.*

^c These Conjectures should not be esteemed Impossibilities : for there are, doubtless, many extraordinary Discoveries still to be made in Vegetation ; as we see some very considerable ones

*The Means of
making Fruit
sweet.*

2. Fruits grow sweet, (1.) by rolling, or pressing them gently with the Hand, &c. (2.) by Rottenness; as Medlars, Services, Hips, &c. (3.) by Time; as Apples, Wardens, &c. (4.) by certain particular Maturations; as by laying them in Hay, Straw, &c. and, (5.) by Fire; as Roasting, Stewing, &c. (1.) The Cause of the Sweetness by rolling, and pressing, is Emolliation; which those Operations properly introduce: as in beating of Stock-fish, &c. (2.) By Rottenness; because the Spirits of the Fruit, thus gather heat, and thereby digest the harder Parts; for in all Putrefaction there is a degree of Heat^a. (3.) By Time, and keeping; because the Spirits of the Body always feed upon the tangible Parts, and attenuate them. (4.) By particular Maturations; because of some degree of Heat. And, (5.) By Fire; because 'tis the proper Work of Heat to refine, and incorporate; for all Sourness consists in some Grossness of the Body: and all Incorporation makes the Mixture of the Body more equal in the Parts; which constantly induces a milder Taste. See the Articles CONCOCTION, MATURATION, PUTREFACTION, TRANSMUTATION, and VEGETABLES.

G.

GENERATION.

*Why some
Creatures ge-
nerate at all,
and some at
different Sea-
sons.*

1. **S**OME Creatures generate but at certain Seasons of the Year; as *Deer*, *Sheep*, *Rabbits*, &c. and most sorts of *Birds*, and *Fishes*: others, at any time of the Year; as *Man*, and all domestick Creatures, as *Horses*, *Dogs*, *Cats*, &c. The Cause of Generation, at all Seasons, seems to be Fullness; for Generation proceeds from Redundancy. This Fullness arises either from the Nature of the Creature, if it be hot, moist, and sanguine, or from plenty of Food. For the first; *Men*, *Horses*, *Dogs*, &c. which breed at all Seasons, are full of Heat and Moisture. *Doves* are the fullest of Heat and Moisture, among *Birds*, and therefore breed often; the tame Dove, almost continually. But *Deer* are melancholy, dry Creatures; as appears by their Fearfulness, and the Hardness of their Flesh. *Sheep* are a cold Creature; as appears by their Mildness, and their seldom Drinking. Most *Birds* are of a dry Substance, in comparison of Beasts. *Fishes* are cold. For the second Cause; viz. Fullness of Food; *Men*, *Kine*, *Swine*, *Dogs*, &c. feed full: and we see that those Creatures which, when wild, generate seldom; generate often, when tame: which proceeds from Warmth, and Fullness of Food. The Rutting-time of *Deer*, is in *September*; for they require the whole Summer's Feed and Grass, to make them fit for Generation: and if Rain come early, about the middle of *September*, they go to rut

ones have lately been. Consult, in particular, the *French Memoirs*; and Mr. Hales's *Vegetable Staticks*.

^a Is this universally true? In particular, does it extend to Animal Flesh, in the case of Mortifications, &c?

^e These are noble Attempts at the Discovery of Causes: but let them be still farther pursued.

not somewhat sooner ; if Drought, somewhat later. So *Sheep*, in respect of their small Heat, generate about the same time ; or somewhat before. But, for the most part, Creatures that generate at certain Seasons, generate in the Spring ; as Birds and Fishes : the End of Winter, and the Warmth and Cheerfulness of the Spring, preparing them for it ^f. Another Reason why some Creatures generate at certain Seasons, is the relation of their time of Bearing, to the time of Generation ; for no Creature goes to generate, while the Female is full, or employed in sitting, or rearing her Young : and therefore, if the Eggs, or young Ones, be taken out of the Nests of Birds ; the Birds will fall to generate again, three or four times successively.

2. Some Creatures remain a longer time in the Womb, and some a shorter. Women commonly go nine Months ; the Cow, and the Ewe, about six ; Does, about nine ; Mares, eleven Months ; Bitches, nine Weeks ; but Elephants are said to go two Years ^g. There are here two Enquiries belonging to Birds ; viz. the Distance between the Treading, and the Laying of the Egg ; and again, between the Laying, and the Hatching ^h. Among Birds, there is a less Difference of Time, than among other Creatures ; yet some there is : for the Hen sits but three Weeks ; the Turkey-hen, Goose, and Duck, &c. a Month. The Cause of this Difference may be, either from the Nature of the Kind, or the Constitution of the Womb ; that is, according as the Hardness, or Dryness thereof, concurs with the former Cause : for the Colt, the Fawn, and the Calf, have about four Years Growth ; but Whelps, which come to their Growth within three Quarters of a Year, continue but nine Weeks in the Womb. As there is less Diversity among Birds, in the Time of their bringing forth ; so is there also, in the Time of their Growth : most of them coming to Maturity within a Year.

The different Time of Gestation in different Creatures.

3. Some Creatures bring many young ones at once ; as Bitches, Hares, Rabbits, &c. some ordinarily but one ; as Women, Lionesses, &c. This may be caused, either by the Quantity of Sperm required, to produce one of that Kind ; which, if less be required, may produce a greater Number ; if more, a smaller : or, by the Partitions, and Cells of the Womb ; which may separate the Sperm ⁱ.

The Cause why some Creatures bring forth many, or few, at a Birth.

4. Some Creatures are generated by Copulation between the Male and Female ; some by Putrefaction ; and many of those by Putrefaction, afterwards procreate by Copulation ^k. The Cause of all Procreation, is a gentle and

The Generation of Creatures by Copulation, and Putrefaction.

^f Let this Doctrine of Fullness be compared with that of Dr. Pitcairn, Dr. Freind, &c. with respect to the Cause of the Menstrues ; which they deduce from Plenitude, Laxity, or Moisture, &c. See Freind's *Emmenologia*, and Pitcairn's *Elementa*.

^g See the Account of Elephants in the *Philosophical Transactions*, Numb. 277 and 358.

^h See Dr. Harvey, *Highmore*, &c.

ⁱ This Enquiry may deserve a farther Prosecution ; notwithstanding the present Doctrine of *Animalcula in Semine Masculino*.

^k Is there any certain, incontestible Instance of Generation by Putrefaction ? This may prove a Question not to be determined hastily ; and, perhaps, the proper Experiments for determining it, are, at present, little considered. Let, therefore, a Set of proper Experiments be

and proportionable Heat, working upon a glutinous and yielding Substance. The Substance being glutinous, produces two Effects: the *one*, that the Spirit is detained, and cannot break out; the *other*, that the Matter being gentle and yielding, is driven forward by the Motion of the Spirits, after some Swelling into Shape and Members. Therefore all *Sperm*, and all the Matter whereof Creatures are produced by Putrefaction, have a Closeness, Lensor, and Tenacity. So that the Generation by *Sperm* only, and by Putrefaction, have two different Causes; viz. (1.) Creatures of an exact Shape, as those procreated by Copulation, cannot be produced by a weak and casual Heat; nor from a Matter which is not exactly prepared, according to the Species. (2.) There is a longer time required to the Maturation of perfect Creatures; for if the time of Vivification be long, the Spirit will exhale before the Creature is mature; unless it be included, where it may have a continuance of Heat, access of Nourishment, and closeness to keep it from exhaling: and such places are the *Matrices* of Females. Therefore all Creatures by Putrefaction, are of a more uncertain Shape; formed in a shorter time; and require not so perfect an Enclosure: tho some Closeness be commonly necessary^l. See the *Articles*, CATERPILLARS, PUTREFACTION, and TRANSMUTATION.

G L A S S.

*Sand of the
Nature of
Glass.*

1. 'Tis reported, that in the Valley near *Mount Carmel*, in *Judea*, there is a *Sand*, which has a great Affinity with *Glass*; insomuch, that other Minerals laid in it, turn to a glassy Substance, without Fire: and again, that *Glass* put into it, turns to the *Mother-sand*^m. The thing is very strange, if true; and may be caused by some natural Furnace, or Heat, in the Earth; yet they speak not of any Eruption of Flames. It were proper to try, in *Glass*-works, whether the crude Materials of *Glass*, mixed with *Glass* already made, will not facilitate the making of the Metal, with less Heatⁿ. See the *Article* TRANSMUTATION.

*The Materials
of Venice
Glass.*

2. The crystalline *Venice Glass*, is reported to be equal Parts of Stones from *Pavia*, by the River *Ticinum*; and of the Ashes of a Weed, called by the *Arabs*, *Kali*, and gathered in a Defart between *Alexandria* and *Rosetta*. 'Tis

be made, upon animal *Flesh*, by means of Putrefaction; with the exactest care, to guard against Flies, and other Insects, or their Eggs: and let the Judgment of the Experimenter remain unprejudiced by the present prevailing System of Generation. This is spoke from an Intimation of some extraordinary Phenomena in such Experiments. See certain Papers upon the Subject, in the *Philosophical Transactions*.

^l This is a Subject of great importance; and to be diligently enquired into by farther Experiment and Observation. 'Tis a great Misfortune, that Men should be apt to raise, and fix a Doctrine upon too few Experiments, (and run great Lengths with it, from whence 'tis hard to return) without waiting for a sufficient Number, before they draw the Conclusion: this hasty kind of Induction, is highly prejudicial to Philosophy.

^m What is the Fact?

ⁿ It may, perhaps, pass for an Axiom; "that all Conversions are forwarded by the Admixture of some Proportion of the Body intended." At least, this is a very useful Rule, in artificial Operations; and capable, by right Application, of producing considerable Effects. It should ever be remembered, that *Simile simili gaudet*. See the *Article* CONTRACTION.

'Tis by the *Egyptians* used, first for Fewel ; then they crush the Ashes into Lumps like a Stone ; and so sell them to the *Venetians* for their Glass-works °.

3. Four things should be tried upon *Glass* ; viz. (1.) the Means to make it more crystalline ; (2.) to make it more strong against Falls, and Fire ; tho it come not to the degree of Malleability ; (3.) to colour it by Tinctures, equal to precious Stones ; (4.) to make a compound Body of *Glass* and *Galletyle*, that shall have the Colour milky, like a *Chalcedon* ; and be a Substance between Porcellane and Glass.

4. For the *first* ; enquire exactly, the several Materials whereof the Glass in use is made ; viz. Window-glass, *Normandy* and *Burgundy* Glass, Ale-house Glass, and *English* Drinking Glass : and consider the Reason of its Coarseness or Clearness ; from thence to assign some Additions to the coarser Materials, for raising them to the Whiteness, and crystalline Splendor of the finest sort.

5. For the *second* ; we see Pebbles, and some other Stones, will cut as fine as crystal ; which, if they will melt, may be a Mixture for Glass, and render it more tough and crystalline. Besides, Metals will vitrify ; and, perhaps, some Portion of the *Glass of a Metal*, mixed in the Pot of ordinary Glass-metal, will make the whole Mass more tough.

6. For the *third* ; enquire into the Ways of making coloured *Window-glass*, such as is tinged in the Pot ; and not by Colours laid on.

7. And *lastly* ; enquire of what Stuff *Galletyle* is made, and how the Colours in it are varied ; and then consider how to make the Mixture of Glass-metal, and that whereof I have seen an Example °.

(2.)
Stronger.

(3.)
By colouring it
in the Pot.
And, (4.) by
compounding it
with other
Matters.

GLOW - WORMS.

The Nature of the *Glow-worm* is not hitherto well observed. They breed chiefly in the hottest Summer Months ; and not in open Champain, but in Bushes and Hedges. Whence, perhaps, their Spirit is very fine ; and not to be subtilized but with the Summer Heats : and, by reason of the Fineness, it may readily exhale. In *Italy*, and the hotter Countries, there is a Fly they call *Lucciole*, that shines as the *Glow-worm* ; and is, perhaps, the *flying Glow-worm*. But this Fly is chiefly found in Fens and Marshes ; tho they are not seen but in the heat of Summer : and Sedge, or other green of the Fens, affords as good Shade as Bushes. Possibly the *Glow-worms* of the cold Countries, ripen not so far as to be winged °. See the *Articles* CATERPILLAR, LIGHT, PUTREFACTION, and VISION.

Of the Nature
and Properties
of the Glow-
worm.

GOLD.

° See this *History* deduced and illustrated in *Neri's Art of Glass* ; with Dr. *Merret's Notes* : or rather *Kunckel's Edition* of the same Work.

° Tho the *Art of Glass* may seem carried to a great height, there is still room for Improvements in it. See Mr. *Boyle*, and M. *Homburg* upon the Subject. But some particular *Glass Men*, of late, have, perhaps, got a few valuable Secrets, that are not known to *Philosophers* and *Writers*.

° They have been found winged in *England*, and shining in hot Weather. There are some curious Observations and Experiments upon the *Glow-worm*, in Mr. *Boyle's Philosophical Works* ; and the *Philosophical Transactions*, particularly Numb. 72 and 176.

G O L D.

The Foundations of an Enquiry for the making of Gold.

1. The World has been much abused by the Opinion of making *Gold*. The *Work itself, I judge possible*^r; but the Means hitherto proposed for effecting it, are, in *Practice*, full of Error and Imposture; and, in *Theory*, full of vain Imaginations. For to say, that Nature has an Intention to make all Metals *Gold*; that if she were freed from Impediments, she would perform her own Work; that if the Crudities, Impurities, and *Leprosities of Metals* were cured, they would become *Gold*; and, that a little Quantity of the Medicine, in the Business of *Projection*, will turn a Sea of the baser Metal into *Gold* by Multiplication; all these are but *Dreams*: and so are many other supposed Grounds of *Alchemy*. To help the matter; the Alchemists also call in many Vanities from Astrology, Natural Magick, superstitious Interpretations of Scriptures, auricular Traditions, feigned Testimonies of ancient Authors, and the like. 'Tis true, they have brought to light many profitable Experiments; and thereby made the World some Amends: but we would treat the *Transmutation of Bodies*, and the *Experiments* concerning Metals and Minerals, so as to lay open the true Ways and Passages of Nature, which lead to this great Effect. And herein we commend the *Chinese*, who despair of making *Gold*; but apply to the making of *Silver*^t: for 'tis more difficult to make *Gold*, the most ponderous of Metals, than to make *Silver*, from *Lead*, or *Quicksilver*; both which are more ponderous than *Silver*: so that they need, rather, a farther degree of Fixation, than any Condensation^u. In the mean time, we will direct an Experiment for the Maturation of Metals, and, thereby, for turning some of them into *Gold*; for, we conceive, that a *perfectly good Concoction, Digestion, or Maturation of some Metals, will produce Gold*^v. I knew a *Dutchman*, who had wrought himself into the belief of a great Person, by undertaking to make *Gold*: his Discourse was, that *Gold might be made; but that the Alchemists over-fired the Work*: for, he said, *the making of Gold required*

^r So have most of the Philosophers, who were well versed, and intimately acquainted with the Ways and Works of Nature and Art; but a thing may be *possible* that is not *practicable*. Let the Doctrine, and Discoveries of Mr. Boyle, Dr. Hook, and Sir Isaac Newton, be consulted upon this Occasion. A Summary of the ancient and modern Doctrine, upon this Subject, may be found in Boerhaave's *Chemistry*. It were, perhaps, less judicious, to consult Morhof and Becher upon this Point; tho Men of extraordinary Parts, Learning, and Experience: but M. Homberg and Dr. Stahl, cannot so well be excepted to. However, the Matter is not to be decided by *Authorities*, but *Experience*.

^t Consult, upon this Occasion, Kircher's *China Illustrata*; and the late Missionaries Letters, particularly those of Father le Compte, &c. See also Morhof's *Polyhist. de Philosophia Naturali Chinesium & Indorum*.

^u The Author seems to agree with some of the Moderns, that to make a Substance as ponderous as *Gold*, is to make *Gold*. But, is Gravity the *Form*, or essential, and constituent Property of *Gold*? and, must all the other Properties; as Yellowness, Fixedness, &c. follow, of direct Consequence?

^v On what precise and internal Knowledge of the constituent Parts of Metals, does this Rule, for Practice, depend? does it relate to their truly *Mercurial Part*? and has the Existence of this Part been sufficiently proved, by Experience, to the Senses?

required a very temperate Heat; as being, in Nature, a subterraneous Work, where little Heat comes; tho more required to the making of Gold than of any other Metal; and therefore, that he would do it with a great Lamp; which should carry a temperate and equal Heat: and, that it was the Work of many Months. The Device of the Lamp might be Folly; but the Over-firing now used; the equal Heat required; and making the Operation the Work of some time, are no bad Intimations.

2. The first Caution is, that a temperate Heat be used; for they are ever temperate Heats that digest and mature. But here we mean, temperate according to the Nature of the Subject: for that may be temperate to Fruits, and Liquors, which will not work upon Metals. The second is, that the Spirit of the Metal be quickened; and the tangible Parts opened: for, without these two Operations, the Spirit of the Metal wrought upon, will not be able to digest the Parts. The third Caution is, that the Spirits spread themselves even, to make the Parts close and pliant. And this requires a Heat that does not rise and fall, but continues equable. The fourth is, that no part of the Spirit be emitted; for, if the Spirit goes out, the Body of the Metal will grow hard and churlish. And this may be prevented, partly by a due Regulation of the Fire; and partly by the Closeness of the containing Vessel. The fifth Caution required is, that Choice be made of the likeliest and best prepared Metal for the Purpose; as this will facilitate the Work. The sixth and last Caution is, that time enough be allowed for the Operation: not to prolong Hope, as the Alchemists do; but to give Nature a convenient Space to work in.

The Rules, or Cautions, required in the Work; viz.
(1.) A Temperate Heat.
(2.) A quickening of the Spirit.
(3.) Equal Diffusion of the Spirits.
(4.) Detention of all the Spirit.
(5.) Choice of a proper Subject.
(6.) A due allowance of Time.

3. These Principles appear just and certain: we will next, therefore, derive a Trial out of them; which may be improved by farther Meditation.
(1.) Make a small Furnace for a temperate Heat; such as may keep the Metal continually melted, and no more: this, above all things, importing to the Work. (2.) For the Material, take Silver, which, in Nature, symbolizes most with Gold: put in also, with the Silver, a tenth part of silver; and a twelfth part of Nitre, to quicken and open the Body of the Metal: and let the Work be continued six Months, at the least. (3.) I recommend also, some oily Substance to be thrown in at times; such as they use in the recovering of Gold, which, by being long tortured with Separations, is become churlish: and this, to lay the Parts more close and smooth,

V O L. III.

N

smooth,

* What is the precise meaning of quickening the Spirit of a Metal? The Alchemists talk much of a fermentative Motion; and endeavour to illustrate the thing by the Effects of Yeast, on Wort. But 'tis very unsafe arguing by Analogy, in these Cases; tho it may well deserve the Enquiry, whether Metals have not a Fermentation, sui Generis; in what precise manner Amalgamation operates; and whether a running Mercury does not, in a proper Sense, contain a metallic Spirit?

* Suppose Silver, therefore, were the Metal to be wrought on; the Furnace should have the same degree of Heat as a Testing-Furnace.

* But not in Gravity: for Quicksilver and Lead, are specifically heavier than Silver.

* Was the extremely Volatility of Quicksilver considered, in ordering this for an Ingredient; when the whole is to be exposed to a Heat capable of keeping Silver fluid?

* There is Sagacity shewn in this particular Direction: and, perhaps, any unctuous vegetable, or animal Matter will suffice.

smooth; which is a principal matter. For *Gold* is the closest, and therefore the heaviest of Metals; and likewise the most flexible and ductile. (4.) To make *Gold* from *Quicksilver*, is not to be expected; because of the great Gravity of *Gold*: and again, because *Quicksilver* will not endure a strong Fire. Next to *Silver*, I shou'd think *Copper* were the fittest to be the Subject.

The Causes of the Properties of GOLD, to be discovered in order to make it. 4. *Gold* has great Gravity; Closeness of Parts; Fixation; Ductility, or Softness; is of a yellow Colour, and not subject to Rust. Therefore the *sure way to make it, is to know the CAUSES of these several Natures*; and the *Axioms* concerning them^a. For if a Man can make a Metal, that has all these Properties; let others dispute whether it be *Gold* or no^b.

G R A V I T Y.

Different Effects of Gravity, above and within the Earth. 1. *It is affirmed*, as an usual Experiment, that a Lump of Ore at the bottom of a Mine, may be raised by two Men; which, on the Surface of the Earth, requires the Strength of six. This Instance should be tried to the full^c: for it is probable, that the power of Gravity is weakened both far above, and deep within the Earth. The former, because the *Appetite of Union* between dense Bodies and the Earth, in regard to Distance, is more dull: the latter, because the Body has, in part, attained its end, when descended to some depth in the Earth. But as for Motion to a Point, which was the Opinion of the Ancients, it is a mere Vanity^d.

Heavy Bodies sustained by Water. 2. The Dead-Sea, which throws up *Bitumen*, is so glutted, that living Bodies thrown into it, bound, have been born up by it: which shews that all sinking in Water proceeds from an over-weight of the Body, in respect of the Water; so that Water may be made strong enough to support Iron: of which I see no Use but *Imposture*. All Metals, except *Gold*, swim upon *Quicksilver*, for the same Reason^e.

Weight acquired by Solution. 3. Weigh Iron, and *Aqua-fortis*, severally; then dissolve the Iron in the *Aqua-fortis*, and weigh the Solution; and you will find it weigh as much as the Bodies did asunder: notwithstanding a great waste, by a thick Vapour that

^a If a proper Set of such *Axioms* were once procured, we might rationally expect either to effect this, and even much greater Matters; or else to know the precise Reasons of their impracticability: As Sir *Isaac Newton* has shewn why Telescopical Glasses must necessarily remain imperfect, unless we cou'd alter the Nature of Light, or the Laws of Refraction; and as we certainly know the Cause why Water will rise but to a certain height in *Pumps*, and Mercury in the common Barometer. These Enquiries having fallen into better Hands than the Enquiries about *Transmutations*; is, perhaps, the Reason, why the Discoveries in the former are more numerous, and better verified, than in the latter. See the *Articles*, ALTERATION, CONCOCTION, FIXATION and TRANSMUTATION.

^b 'Tis an Axiom, or *identical Proposition*, that a Body having all the Properties of *Gold*, is *Gold*. For the Method of conducting all such Enquiries, See the *Novum Organum*, Part II. Sect. I.

^c Is the Fact verified to this Day?

^d Bating for the Form of Expression, does not this Paragraph intimate the Substance of the present *Doctrine of Gravity*; tho not the Ratio, or precise Line of Descent in heavy Bodies?

^e Here is a Foundation for the modern Improvements in *Hydrostaticks*, by an easy Translation and Enlargement.

that issued during the Dissolution : which shews, that the opening of a Body may increase the Weight. This was tried once or twice ; but I know not whether there were any Error committed ^f.

4. A Solution of two Drams of *Quicksilver*, in two Ounces of *Aqua-fortis*, will not support a Flint, the size of a Nutmeg : yet, no doubt, to increase the weight of Water, will increase its power of supporting ; as we see in Brine, which, when strong, will bear an Egg ^g. But it seems that the weight of *Quicksilver*, above the weight of a Stone, doth not compensate the weight of a Stone, above the weight of *Aqua-fortis*. *The Floating of Solids upon Fluids.*

5. Two Bodies of unequal weight, as Wood and Lead, join'd together, being thrown out of the hand, with the light end foremost, will turn, and the heavier end get before ; unless the Body be over long : for the denser Body sustains a stronger pressure of Parts from the first Impulse ; which is the Cause of all violent Motion : and when the hinder part moves swifter, (as enduring less Pressure) than the fore part can make way for it ; the Body must needs turn over : because it can thus more easily draw the lighter part forward ^h. *The different Motions of Bodies of different Gravities.*

6. *Galilæo* well observes, that if an open Trough of Water be moved faster than the Water can follow ; the Fluid gathers in a heap behind : which he supposes to be the cause of the *ebbing and flowing of the Sea* ; viz. because the Earth moves faster than the Sea. Which Theory, tho false ^k, yet the first Experiment is true. The unequal pressure of Parts, appears manifestly in this ; that if you take a Body of Stone, or Iron, and another of Wood, of the same magnitude and shape, and throw them with equal Force ; you cannot throw the Wood so far as the Stone or Iron. ^l

G R O W T H.

The *Acceleration of Growth*, or Stature, must proceed, either, (1.) from due Nourishment ; (2.) the Nature thereof ; or (3) the quickning and exciting of the natural Heat. (1.) As for the first ; excess of Nourishment is hurtful ; as making the Child to grow corpulent ; or more in Breadth than Height : like Plants, which, if they spread much, are seldom tall. (2.) As for the *Nature of the Nourishment* ; it shou'd not be too dry ; whence Children in *Dairy Countries* grow taller than where they feed more upon Bread and Flesh. There is also a *received Tale* ; that boiling of Dairy-Roots, which are great Dryers, in Milk, will make Dogs little. But so much is true ; that an over-dry Nourishment, in Childhoood, retards the Stature. *The Acceleration of Growth and stature in Man.*

N 2

nishment

^f Compare this with an exact Trial of the same kind, in the *Philosophical Transactions*, N^o 531.

^g See the Article CONTRACTION.

^h Compare this with Sir *Isaac Newton's Laws of Motion*.

ⁱ See the Author's Treatment of this Subject in the *Novum Organum* ; and the fifth Part of his *INSTAURATION*.

^k Is this Conjecture absolutely false ? See Sir *Isaac Newton*, and Dr. *Halley* upon the Subject.

^l This Subject has been prosecuted by many ; but by few perhaps, to greater Advantage than by Sir *Isaac Newton*.

rishment must also be of an opening Nature ; for that attenuates the Juices, and promotes the Motion of the Spirits upwards. (3.) As for the *quickening of natural Heat* ; this must be effected chiefly by Exercise : and therefore, Childrens going to Shool, where they sit long, hinders their Growth ; whereas Country-People, that go not to School, are commonly of better Stature¹. And again ; Men must beware how they give Children any thing that is cold, in its Operation ; for even long Sucking hinders both the Wit and Stature. It has been tried, that a Whelp fed with Nitre, in Milk, became very little ; but extremely lively : for the Spirit of Nitre is cold. And tho Nitre be an excellent Medicine, in full grown Persons, for the Prolongation of Life^m ; yet in Children and young Creatures, it hinders Growth ; and all for the same Reason : Heat being requisite to Growth. But after a Man is come to middle Age, Heat consumes the Spirits ; which the Coldness of the Spirit of the Nitre helps to condense and correctⁿ.

H.

HARDNESS and SOFTNESS.

The Cause of Hardness, and Softness, in Bodies. **S**OME Bodies are *hard*, and some *soft*. *Hardness* is caused chiefly by the jejuneness of the Spirits ; and their disproportion to the tangible Parts : both which, if in a greater degree, make them not only hard, but fragile, and less capable of Pressure ; as Steel, Stone, Glafs, dry Wood, &c. *Softness* proceeds from the great quantity of Spirits, and the more equal spreading of the tangible Parts ; which thereby become more sliding : as in Gold, Lead, Wax, &c. But soft Bodies are of two Kinds ; the *one* easily giving way, without altering the Bulk by rising in other places : as in printing of Wax, the Wax does not rise, but only the depreſs'd part gives place ; and the other remains as it was. The *second* kind alters the Bulk in yielding ; as Water, or other Liquors ; which, if a Stone be thrown into them, easily give way : but then they rise over ; which is a *false yielding* ; as being a yielding in place, and not in Substance^o.

H E A T.

Expedients to discover the Power of Heat, in occluso. 1. Of all the Powers in Nature, *Heat* is the chief ; both in the Frame of Nature, and in the Works of Art. It is likewise certain, that the effects of Heat

¹ How far is this verified by Experience ?

^m See the Author's *History of Life and Death*.

ⁿ The Author does not appear to mean the Chemical *Spirit of Nitre* ; but the native Spirit, naturally contain'd in the crude Salt. And certainly it deserves a careful Examination, what are the true Virtues and Uses of Nitre. Dr. Stahl and Dr. Hoffman, have begun the Enquiry ; but the Physicians of England seem to neglect the Medicine : I know not whether from finding it of little Efficacy ; or thro' want of Attention. The Author recommends it highly ; and so do many Foreigners.

^o See Mr. Boyle's *Essays upon Fluidity and Firmness ; Volatility and Fixedness, &c.* and Sir Isaac Newton's *Queries*, at the End of his *Opticks*. But the Subject seems to require a still more exact and practical Enquiry.

Heat are most advanced, when it operates upon a Body without loss, or dissipation of the Matter; which always defrauds the Account: and therefore the power of Heat is best perceived in *Distillations*, performed in close Vessels and Receptacles^p. Yet there is a higher degree; for however Distillations may keep the Body confin'd in Cells and Cloysters, yet they allow it room to turn into Vapour; return into Liquor; and to separate one part from another. So that Nature here expatiates, tho not at full Liberty; whereby the true and ultimate Operations of Heat are not attained. But if Bodies may be alter'd by Heat, and yet no such Reciprocation of Rarefaction, Condensation, and Separation, admitted; probably this *Proteus* of Matter, being held by the Sleeve, will undergo many *Metamorphoses*. Take, therefore, a square Vessel of Iron, in form of a Cube; and let it have thick and strong Sides^q. Put into it a Cube of Wood, that may fill it quite close; let it have a cover of Iron, as strong as the Sides; and lute it well, after the manner of the Chemists. Then place the Vessel within burning Coals, kept quick kindled, for a few Hours. Now take the Vessel from the Fire; open it, and see what is become of the Wood^r. I conceive, since all Inflammation and Evaporation are entirely prevented, and the Body still turned back upon itself, that either the Wood will be converted into a kind of *Amalgama*; or that the finer part will be turned into Air; and the grosser stick, as it were baked, upon the sides of the Vessel; being become a denser Matter than the crude Wood itself.

2. For another Trial; put Water into the like Vessel, stopp'd as before; but use a gentler Heat, and remove the Vessel sometimes from the Fire; and again, when cold, renew the heating; and repeat the Process alternately, for a few times^s: and if once the Water, which is one of the simplest of Bodies, be changed in Colour, Odour, or Taste, after the manner of compound Bodies, there is a great Work effected in Nature; and a considerable Entrance made into strange Changes of Bodies, and new Productions: as also a way opened to do that by Fire in a short time, which the Sun and Age do in a long one. The Effects of this close Distillation, *which is like the Wombs and Matrices of living Creatures, where nothing expires, nor is separated*, may be admirable; tho without aiming to make the *Pigmies* of *Paracelsus*, or any such prodigious Follies: but perhaps the Effects

^p The Author seems to mean what the Chemists call *Circulation*, or Digestion; where the Subject rises in Vapour, and is returned back upon itself.

^q What is the *DIGESTOR* more than an obvious Improvement of this Contrivance? But who has pursued the Experiment, besides *M. Papin*?

^r There may be danger in the Trial, from the bursting of the Vessel; unless a weaker part be purposely left at the Top, that shall give way sooner than the Sides, and so the Explosion, if any shou'd happen, be directed up the Chimney. The fear of this Accident has, perhaps, deter'd many from making the Experiment; or, at least, from applying it to Quicksilver, and other metallick Bodies. But Prudence, and mechanical Skill, may direct a Vessel to be made, that shall not be liable to any fatal Contingency.

^s This Experiment also may require some Caution, to prevent its proving mischievous; for Water heated in Confinement, has a great explosive Power. A skillful and wary Operator shou'd be, therefore, employ'd in these kinds of Experiments.

fects of this Heat, will be such, as wou'd scarce be imagined, if the Force of it be entirely kept in †.

*The different
HEATS of Fire
and boiling
Water,*

3. *Fire* applied to burning Wood, makes it first luminous ; then black and brittle ; next, jagged ; and thus reduces it to Ashes : but *scalding Water* has none of these Effects. The *Cause* is, that by Fire the Spirit of the Body is first rarified, and then emitted ; the Refinement and Attenuation whereof produces Light whilst the Emission produces, first Fragility, and next, Dissolution into Ashes : and this at the time that no other Body enters. But in *Water* the Spirit of the Body is not rarified so much ; and besides, part of the Water enters ; which encreases the Spirit, and in some degree extinguishes it : whence hot Water will quench Fire. Again, in Bodies, where the *Water*, does not enter much, but only the Heat passes ; we see, hot Water produces the Effects of Fire : thus there is scarce any difference between Eggs boil'd, and roasted † ; but in Fruit, and Flesh, where the *Water* in some measure enters, the difference is much greater †.

*Of different
Heats working
the same Ef-
fects,*

4. The *Heat of the Sun*, for ripening of Fruits, and the *heat of Vivification* in living Creatures, are both supplied by the *heat of Fire* : and the Heats of the Sun, and Life, are represented one by the other. To set Trees at the back of a Chimney, ripens the Fruit the sooner. Vines drawn in at the Window of a Kitchen, have yielded Grapes a Month before other Vines. Stoves at the backs of Walls, produce Oranges here in *England*. Eggs are hatched by the warmth of an Oven. And 'tis reported, that the Ostrich lays her Eggs under Sand ; where the heat of the Sun hatches them †.

5. The

† The Author has judiciously reasoned up to the Experiment : which now alone must determine of the Fact. The uncommon Effects of a *slight DIGESTOR*, with a *small degree of Heat*, employ'd in a few Subjects, might be sufficient Encouragement to urge the Discovery ; and press Nature closer, in a variety of Subjects. The Mine is open, and Chemistry expects Enrichment from it.

‡ Let the *Instances* wherein *hot Water* and *Fire* agree be sought ; and again, those wherein they differ ; and let them be ranged, or tabled, according to the Direction of the *Novum Organum*, Part II. Sect. 1. where the general Method of conducting Enquiries is deliver'd. There are some particulars, for this purpose, to be found in the *Philosophical Transactions*, and *French Memoirs*.

§ The different Natures and Effects of different kinds of Heat, have been but little attended to ; tho a very material Article in Chemical Operations : where it will, perhaps, be found, that the *Heat of Water* may perform Operations, which cou'd not be effected by the *Heat of Sand*, & *vice versa* : and this, not because they are different degrees of Heat, about which alone the common Chemistry seemsto be concerned ; but because the Heats are of different Natures, or have different Properties. The Foundation for the Enquiry is here laid by the Author : and, if duly prosecuted, might give great Light to Chemistry, and Natural Philosophy. Thus, in particular, may not *Vitriol* be purified, in an extraordinary manner, for certain purposes ; by a repeated dissolution of the Body, *per se*, in a Glass Vessel, set in *Balneo Mariae*, without any additional Moisture within the Glass ? And can this Operation be performed by the heat of a Lamp, Sand, Ashes, naked Fire, or any other than a *moist Heat* ? See *Philosophical Transactions*, N^o 103.

¶ This Paragraph is Correlative to the preceding ; as containing *Instances wherein different Heats agree* ; according to the Direction of the *Novum Organum*. And unless that Piece be well understood, and kept in Mind, the Reader cannot easily perceive the Tendency, and Merits of the present Work : which is not intended for Curiosity, Agreeableness, Amusement,

or

5. The Water of Wells is warmer in Winter than in Summer; so is the Air in Caves*: Because in the upper Parts, under the Earth, there is a degree of Heat; (as appears in Veins of Sulphur, &c.) which, being shut up close, as in Winter, is greater; but if it perspire, as in Summer, less.

6. In Peru, and several Parts of the West-Indies, tho' under the Line, the Heats are not so intolerable as in Barbary, and the skirts of the Torrid Zone. The CAUSES may be these; (1.) the strong Breezes which the motion of the Air in great Circles of the Earth produces, refrigerate; whence the Noon in those Parts is not near so hot, when the Breezes are great, as about nine or ten a-Clock in the Morning. (2.) The length of the Night, and the Dews thereof, which abate the Heat of the Day. (3.) The Continuance of the Sun, in respect of the Season; for under the Line the Sun crosses the Equinoctial, and makes two Summers, and two Winters; but in the skirts of the Torrid Zone, it doubles, goes back again, and so makes one long Summer.

7. The bottom of a Vessel of boiling Water is not so hot, but that a Man may apply his Hand to it: The CAUSE may be, that the moisture of Water allays Heat where it touches; and therefore Moisture, tho' it pass not thro' Bodies, without Communication of Substance; as Heat and Cold do; yet works manifest Effects, by its qualifying of Heat and Cold; as in the present Instance. We see likewise, that Waters distill'd with a Bath-heat, differ much from Waters distill'd by direct Fire. So Pewter-dishes with Water in them, do not easily melt; but without it, readily: nay, Butter and Oil, which in themselves are inflammable, yet by virtue of their Moisture have the like Effect.

8. Fire and Heat have similar Operations in numerous Instances. Heat dries Bodies that easily expire; as Parchment, Leaves, Roots, Clay, &c. Fire and Heat, in several Effects.

or Pleasure; but solely levell'd at the Investigation of Causes; the Discovery of Forms; and the production of Capital Effects. To inculcate this more than once, may not be unreasonable; as Men appear but little acquainted with the Thing in general, or the direct Design, and immense Utility, of the present History, in particular.

* Viz. With regard to the Body, and the Heat or Coldness of the Air without: but how stands the particular, with regard to the Thermometer, or other still more exact Methods of Trial? See Mr. Boyle, in the Entrance of his History of Cold; and the Pieces of M. Amontons, and others, in the French Memoirs.

† This Enquiry deserves to be farther prosecuted. See Mr. Boyle's Pieces of the Subterranean and Submarine Regions, &c.

‡ I have heard the Fact attested by Travellers.

§ See Varenii Geographia Generalis.

|| This Experiment may be tried without danger of burning, provided the Water be made to boil strongly; and the bottom of the Vessel, in that State, be immediately clapt upon the hand, and not continued after the bubbling, or boiling Motion, of the Water ceases.

¶ Is there not some more deep and latent Cause of this Effect? For the bottom of the Vessel will burn the Hand, after the Water ceases to boil: tho' the Water, perhaps, now remains as moist as before.

‡ How are Pewter Vessels affected, when set over the Fire with Fluid Bodies in them that are not moist, as Quicksilver, for Instance? To discover the true Natures of Heat and Fire are subtle Enquiries; upon which very great Matters depend. Sir Isaac Newton has left us some considerable Hints for the Prosecution, in his Queries at the End of his Opticks.

so does *Time* or *Age* ^c. *Heat* dissolves and melts Bodies that retain their Spirits, as in many Liquefactions; and so doth *Time* in some Bodies of a softer Consistence: as appears in *Honey* and *Sugar*, which by *Age* grow more liquid; and in old *Oil*, which is always more clear, and hot in medicinal Use. *Heat* causes the Spirits to search some Issue out of the Body; as in the Volatility of Metals ^f: so does *Time*; as in the Rust of Metals ^g. But generally *Heat* does that in a small time, which *Age* doth in a long one ^h.

Their different Operations in others.

9. Some Things which have passed the Fire, are softest at first, and by time grow hard; as Crumbs of Bread. Some are harder when they come from the Fire; and afterwards give, and grow soft again; as the Crust of Bread, Bisket, Sweatmeats, Salt, &c. For in those things that grow hard with Time, the Operation of the Fire is a kind of melting: and in those that grow soft with Time, the operation of the Fire is a kind of baking: and whatever the Fire bakes, Time in some degree dissolves ⁱ. See the Articles AIR, COLD, and COOLNESS.

H I C C U P.

Of the Cause and Cure of the Hiccup.

Sneezing has been observed to stop the *Hiccup*. The CAUSE may be, that the Motion of the *Hiccup* is a rising up of the Breast, which sneezing somewhat depresses; and diverts the Motion another way. The *Hiccup* proceeds, (1.) from fullness of Meat; especially in Children; which causes an extension of the Stomach. (2.) It is also caused by acid Meats, or Drinks, pricking and vellicating the Mouth of the Stomach. This Motion is eased either, (1.) by a *Diversion*, or (2.) a *Detention* of the Spirits: by *Diversion*, as in Sneezing; by *Detention*, as in holding the Breath: which somewhat helps to stop the Hiccup. Putting the Person into an earnest Study ^k, does the like. Vinegar also, applied to the Nostrils, or gargled in the Mouth, has the same effect; as being Astringent, and suppressing the Motion of the Spirits ^l. See the Articles SNEEZING and YAWNING.

H U N G E R,

^c By Time and Age we are here, perhaps, to understand no more than *Opportunity*: as length of Time has no direct Agency upon Bodies itself; only affords an opportunity for their being acted upon by the Air, with its several Ingredients; which proving a kind of Menstruum, works upon, and tinges itself with, the finer Particles of Bodies; and so at length leaves them effete, or reduced to a kind of Calx, or *Caput Mortuum*: and thus are introduced Dryness, Rottenness, Corruption, Changes, and, possibly, Regenerations, or new Combinations, in all the sublunary Bodies: for the *Sum of Matter* is ever the same.

^f This may illustrate the preceding Note; as not Time, but the aqueous or corrosive Spirit, or some particular Power in the Air, seems to be the Cause of Rust.

^g For all Metals, even Gold itself, is Volatile, with a suitable degree of Heat; as we see in the *Burning Concave*.

^h And therefore Heat is a Capital Power in Nature.

ⁱ Here again we have the Foundation of a noble Enquiry, directly leading to the production of considerable Effects. But for the way of prosecuting it to purpose, consult the *Second Part* of the *Novum Organum*.

^k Or a sudden Fright.

^l Do the Causes here assign'd reach to that *Hiccup* in Compound Fevers, and other Diseases; which is usually accounted a fatal Symptom; and for which no certain Remedy is hitherto known?

H U N G E R, or A P P E T I T E.

The Appetite is excited chiefly by Things that are *cold* and *dry*; for Cold is a kind of Want in Nature, that calls for supply; and so is Dryness: therefore (1.) all Acids, as Vinegar, juice of Lemmons, &c. provoke the Appetite. And the Disease call'd *Appetitus Caninus* consists in an acid Phlegm, lodged in the Mouth of the Stomach^m. (2.) Again, the Appetite is moved by four Things; as these induce a Contraction in the Nerves placed at the Mouth of the Stomach: which is a great Cause of Appetite. (3.) But Onions, Salt, and Pepper, in baked Meats, provoke the Appetite by vellicating those Nerves. (4.) Wormwood, Olives, Capers, &c. which participate of Bitterness, excite the Appetite by Absterfion. So that there are *four principal CAUSES of Appetite*: viz. (1.) Refrigeration of the Stomach, join'd with some degree of Dryness; (2.) Contraction; (3.) Vellication; and (4.) Absterfion; besides *Hunger*, which is an emptiness. And yet over-fasting often *causes* the Appetite to cease; for, want of Meat makes the Stomach attract the Humours: and such as are light and cholerick damp the Appetite mostⁿ. See the *Article* FOODS.

The Nature and Causes of APPETITE in the Stomach.

I.

I M A G I N A T I O N.

1. **M**EN are to be admonish'd, *not to reject Operations by the Trans-* *The Notion of*
mission of Spirits, and the Force of Imagination; only because the *the Transmis-*
 Effects sometimes fail: for, as in *Contagions from Body to Body*, the Infection *sion of Spirits,*
 may be often received by the passive Body; but, by the Strength and good *and the Force*
 Disposition thereof, be repulsed and thrown out, before it forms into a Disease; *of Imagination,*
 so much the rather in *Impressions from Mind to Mind*, or from Spirit to *not to be re-*
 Spirit, the Impression may be made; but, being encountered and over- *jected.*
 come by the Mind, and the passive Spirit, produce no manifest Effect^o.
 And therefore, these Impressions operate most upon weak Minds, and
 Spirits; as those of Women; sick Persons; the Superstitious and Fearful;
 VOL. III. O Children

^m Is this certain? Perhaps no Causes in all Physicks are less known, than the true and proper Causes of Diseases; which alone can direct the Physician: and without them, all is guess-Work, Diffidence, and Darknesh. The improvement of Medicine, therefore, requires a thorough Enquiry into the Causes of Diseases. See the *Article* MEDICINE.

ⁿ Perhaps it were not amiss to begin the Enquiry for improving Medicine, with the Stomach; which distributes to other Parts the Supplies of Health and Sicknesh. The Foundations for such an Enquiry are nobly laid by the Author; but few seem to have followed him closely, in the tracing of Nature, finding out her ways, and investigating the Causes of Health and Diseases. His *History of Life and Death* affords an illustrious Example, for entering upon, and conducting, *medicinal Enquiries*.

^o This may deserve to be well consider'd, as opening a new Scene in Nature: but let the Judgment be well guarded here, and not give way to Vanities, Superstitions and Illusions. The Business is to find out the Laws and secret Workings of Nature, by close and attentive Observation; without coining any Thing.

Children, and young Creatures ^p. As for their want of Power upon Kings and Magistrates; it may be ascribed to the weakness of the Imagination, in the Imaginant: for 'tis hard for a *Witch* or a *Sorcerer* to put on a Belief, that they can hurt such Persons ^q.

Nor too credulously believed.

2. Men are also to be admonished, on the other hand, *that they do not easily give Credit to these Operations*; only because they often succeed: for this Success is frequently owing to the Force of *Affection*, and *Imagination*, upon the Agent; and operates by a secondary Means upon a different Body: for Example, if a Man wear a *Planet-Seal*, or a *Bone-Ring*, *believing strongly* that it will help him to obtain his Mistress; preserve him unhurt in Fight; or the like; it may make him more active and industrious; more confident and persisting, than otherwise he would be. Now, we know, that the Effects of Industry and Perseverance, especially in civil Business, are great: For Audacity, in some measure, binds and conquers the weaker sort of Minds; and the State of human Actions is so variable, that to try Things often, and never give over, works Wonders! It were therefore a Fallacy, and Mistake, to ascribe that to the *Force of Imagination, upon a foreign Body*, which is but the *Force of Imagination upon the proper Body*: for Imagination, and vehement Affection, work strongly upon the Body of the Imaginant.

A third Admonition, not to mistake the Fact.

3. Men should also be admonished, *not to mistake the Fact, or Effect*; and rashly conclude that done, which is not. For wise Judges do not hastily believe the *Confessions of Witches*, nor the Evidence against them: the *Witches themselves being imaginative*; and often believing they do what they do not: and *People are credulous in this Point*; and ready to impute *Accidents, and natural Operations, to Witchcraft*. 'Tis worth observing, that both in ancient, and later Times, the great wonders related of Witches flying in the Air, transforming themselves, &c. are always said to be wrought, not by *Incantations or Ceremonies*, but by *anointing themselves all over: which may justly lead one to think, these Fables are the Effects of Imagination*: for Ointments stop the Pores, shut in the Vapours, and send them to the Head extremely. The particular Ingredients of these *magical Ointments*, are, probably, Opiate and Soporiferous: and anointing of the Forehead, Neck, and along the Back-Bone, is used for procuring deep Sleeps. If it be said that this Effect is better procured by inward Potions; we answer that the Ingredients of the Ointment are so strong, that if used internally, they might kill the Person; and therefore work powerfully as Externals ^r.

The several ways wherein the Transmission of Spirits, and the Imagination act, viz.

(.)
By Aerial Effluvia.

4. *All Operations by Transmission of Spirits, and by Imagination, operate at a Distance, not in Contact*; and are as follows. (1.) The *Transmission, or Emission, of the thinner and more airy Parts of Bodies*; as in Odours and Impressions: and this of all others is the most Corporeal. But there are many of

^p Nescio quis teneros oculus mihi fascinat Agnos.

^q Let Judgment be suspended; at least till the Author has been fully heard.

^r Surely there is great Sagacity and Judgment shewn in deriving these Particulars; whilst the Facts themselves are steadily kept in View: insomuch that a little farther prosecution of the Subject, might, perhaps, unravel the whole Secret of *Witchcraft*.

of these Emissions, both wholsome and unwholsome, that yield no Scent; as the Plague: and many wholsome Airs, as they appear to be by dwelling in them, and other Proofs, differ not in Smell from others. Under this Head, we rank all *Imbibitions of Air*, where the Substance is material, in the Form of Odour; some whereof are strange, and very suddenly diffused; as in the alteration which the Air receives in *Egypt*, upon the rising of the River *Nile*.

5. (2.) The *Transmission* or *Emission of what we call spiritual Species*; as (2.) the visible and the audible: which move swiftly, and to a great Distance; but then they require a Medium well disposed: and this Transmission is easily stopped. Spiritual Species.

6. (3.) The *Emissions which cause Attraction of certain Bodies at a Distance*; (3.) as the Attraction of Amber, Jet, and other electric Bodies; the Attraction of Gold, as to Quicksilver at a distance, &c. Attractions.

7. (4.) The *Emission of Spirits, and immaterial Powers and Virtues, in those Things which work by the general Configuration and Sympathy of the World*; (4.) not by Forms, or celestial Influences, but by the primitive Nature of Matter, and the Seeds of Things. Of this kind is the Operation of the Loadstone*, by Consent with the Globe of the Earth; the Motion of Gravity, by the Consent of dense Bodies with the Earth*; some disposition of Bodies to Rotation, and particularly from East to West; whence the principal Flux and Reflux of the Sea†; viz. by Consent of the Universe, as a part of the diurnal Motion. These immaterial Virtues have this peculiar Property, that the difference of Medium does not obstruct them; but they pass through all Mediums, tho at determinate Distances‡.

8. (5.) The *Emissions of Spirits, or the Operation of the Spirits of the Mind upon other Spirits*: and this is of a double Nature; including the Operation of the Affections, if they be vehement; and the Operation of the Imagination, if it be strong. But these two are so coupled, that we must treat them together; for when an *erotic*, or *amorous* Aspect infects the Spirits of another, the *Affection and Imagination are united*‡. (5.) The Spirits of the Mind.

9. (6.) The *Influences of the heavenly Bodies*, besides those two manifest ones of *Heat* and *Light*. (6.) Celestial Influences.

10. (7.) The *Operations of Sympathy*, brought by the Writers of natural Magick into an Art; which is, in order to superinduce any Virtue or Disposition in a Person, to chuse the living Creature, wherein that Virtue is most eminent; (7.) The Operations of Sympathy.

O 2

* See Mr. Boyle's *Treatise of Effluvia*, &c. particularly his *Memoirs for a general History of the Air*.

† See the *Articles* SOUND, and VISION.

‡ See the *Articles* ATTRACTION, and ELECTRICITY.

§ See the *Article* MAGNETISM.

¶ See the *Article* GRAVITY.

‡ See the *Novum Organum*. Part II. Sect. I.

§ See the several kinds of *Motions*; *Nov. Organ.* Part II. Sect. II. and the *Articles* NATURE, SPIRITS, and SYMPATHY.

¶ The subsequent part of the Discourse regards chiefly these two Particulars jointly. See below § 12, &c.

ment ; of this Creature to take the Parts wherein that Virtue chiefly lies ; and again to take these Parts in that Time and Act, where and when the Virtue is most exercised ; and then apply it to that part of the Man wherein the same Virtue chiefly consists^a. Thus for Example, *To superinduce Courage* ; take a Lion, or a Cock ; and chuse the Heart, Tooth or Paw of the Lion ; or the Heart or Spur of the Cock : take these Parts immediately after the Lion, or the Cock, has been in Fight ; and let them be worn upon a Man's Heart, or Wrist^b.

(8.)
*The Sympathy
of Individuals.*

11. (8.) The last Operation is an *Emission of immaterial Virtues* ; such as we hesitate to propose, they are so prodigious ; we mean the *Sympathy of Individuals* : for as there is a *Sympathy of Species*, so perhaps of *Individuals*, that is of Things, or the Parts of Things, which having been once contiguous or entire, there remains a Transmission of Virtue from the one to the other ; as between the *Weapon* and the *Wound* : whence the Operation of the *Weapon-salve*, and Things of that kind, are blazed abroad^c.

*The Emissions
of Spiritual
Species which
affect the Sen-
ses.*

12. The *Emissions of Spiritual Species*^a, should be treated under their proper Titles, of *Visibles* and *Audibles*, apart^c : but there are some *general Observations* common to them both. Thus (1.) They both seem to be incorporeal. (2.) They work swiftly. (3.) They operate at great Distances. And (4.) In curious Varieties. (5.) They are not effective of any Thing ; or leave no Works behind them ; but are mere *Energies* : for their working upon Mirrors, and places of Echo, does not alter any thing in these Bodies ; but 'tis the same Action with the Original, only reflected. The shaking of Windows ; the percussion of the Air by loud Noises ; and the Heat caused by Burning-glasses ; are rather Concomitants than Effects of the *audible* and *visible Species*. (6.) Lastly, They seem of so tender and weak a Nature, as to affect only such an attenuated Substance as the Spirit of living Creatures.

*The Emission of
immaterial
Virtues from
the Minds and
Spirits of Men,
by Affections,
Imaginations,
and other im-
pressions.*

(13.) 'Tis reported, that when Children have been exposed, or taken away young from their Parents ; and afterwards came into their Parents Presence unknown ; the Parent has felt a secret Joy, or other Alteration, upon it^d. An *Egyptian* Soothsayer made *Antony* believe that his Genius, tho otherwise brave and confident, was, in the Presence of *Octavius Cæsar*, poor and cowardly ; and therefore advised him to absent himself. The Soothsayer was thought to be suborn'd by *Cleopatra*, to make *Antony* live in *Egypt*. However, the Opinion of a *predominant*, or *mastering Spirit* of one Man over another, is ancient, and still received, even in vulgar Opinion^e. There are

^a See the *Article* SYMPATHY.

^b Let not the Author here be consider'd otherwise than as an Enquirer : it were very hard if a Philosopher were to be thought tainted with all the Superstitions he is obliged to examine. See hereafter § 22.

^c See the *Article* NATURE, SPIRITS, and SYMPATHY. See also the *de Augmentis Scientiar*, Sect. VIII. 7. and the *Fable of Proserpina* in the *Sapientia Veterum*.

^d See above, §. 5.

^e As they are under the *Articles* SOUND and VISION.

^f Let the Fact be fully enquired into.

^g Every Man has it in his Power to examine this Matter : and are we not all affected in this manner ? Have not some certain Persons an awe upon us, not only in Courts of Justice, and

are Opinions abroad, that some Men of an ill and melancholy Nature, incline the Company where they come, to be dull and sad; whilst others of a jovial Temper, dispose the Company to Mirth and Chearfulness: and again, that some Men are lucky to be in ones Company, or employ'd in Business; and others unlucky. And certainly, 'tis agreeable to Reason, that there should be some *light Effluxes from Spirit to Spirit*, when Men are in Presence one with another, as well as from *Body to Body*. It has been observed, that old Men, who loved young Company, and been continually therein, were long lived; their Spirits, as it should seem, being recreated by their Company. Such were the ancient Sophists and Rhetoricians; that constantly had young Auditors and Disciples; such as *Gorgias, Protagoras, Isocrates, &c.* who lived till they were an hundred Years old. So likewise did many of the Grammarians and School-masters, as *Orbilius, &c.* ^b

14. *Audacity and Confidence in Civil Business*, have such great Effects, that one may reasonably suspect, besides the daring, earnestness, persisting, and importunity, there should be some *secret Binding and Stooing* of other Mens Spirits to such Persons. The Affections make the Spirits more powerful and active; especially those that draw them into the Eyes; which are two: *Love and Envy*. ^k For *Love*; the Platonists hold, that the Spirit of the Lover *passes into the Spirit of the Persons loved*; which causes the desire of return into the Body whence it was emitted: whereupon follows that Appetite of Contact and Conjunction in Lovers. And 'tis observed, that the Aspects which procure Love, are not Gazings, but *sudden Glances and Dartings of the Eye*. *Envy*, which is call'd an *evil Eye*, seems to emit some malignant and poisonous Spirits, that take hold of the Spirits of another; and is said likewise to be of greatest Force, when the cast of the Eye is oblique. This Passion has also been noted as most dangerous, when an envious Eye is cast upon Persons in Glory, Triumph, and Joy: because at such Times the *Spirits* come most into the outward Parts; and so meet the Percussion of the envious Eye. And it has been observ'd, that after great Triumphs, Men have been ill-dispos'd for some Days. The Opinion of *Fascination* is ancient and noted, for both Effects; viz. for procuring *Love*, and *Sickness* from *Envy*; and *Fascination is ever by the Eye*. ^l Yet if there be any such Infection from Spirit to Spirit; no doubt it works by Presence, and not by the Eye alone; tho most forcibly by the Eye. ^m *Fear* and *Shame* are likewise infectious: the starting of one Person, will make another ready to start; and when a Man is out of Countenance, in Company, others blush with him.

The Operations of the Affections at a Distance.

15. Those

the Courts of Princes, but in common Conversation? And does not our Spirit stoop, or strike Sail as it were, to one Man more than another? And this as well from having only heard his Character, as being in his Company? These Particulars should not be slightly pass'd over; if they are Phenomena in Nature.

^b See the *Author's History of Life and Death*.

ⁱ See the *Author's Essays upon Ambition, Anger, Boldness, Nature in Men, Vain-Glory, &c.*

^k See the *Author's Essays upon Love and Envy*.

^l *Nescio quis teneros Oculis mihi fascinat Agnos.*

^m Do not we all form our Conjecture, how a Person stands affected to us, from the Eye?

*The Force of
Imagination,
imitating that
of Sense.*

15. Those Effects which are wrought by striking the Senses, and by things in fact, are likewise produced, in some degree, by the *Imagination*: thus, if a Man see another eat sour things, which set the Teeth on edge; this Object taints the Imagination, and sets his Teeth also on edge, by *Aspect*. So if a Man see another turn long, and swiftly; or if he look upon Wheels that turn; himself grows giddy. So if a Man be upon a high Place, without Rails, or good Hold, unless he be used to it, he is ready to fall: for, *imagining a Fall, it puts his Spirits into the very Action of a Fall*. So upon seeing others bleed, or strangled, or tortured, many are ready to faint; as if themselves bled, or suffered^a.

*A Specimen of
a strict Enquiry
into the Force
of Imagi-
nation upon
other Bodies;
and the Means
to strengthen
it.*

16. We come next, to consider the *Force of Imagination upon other Bodies, and the Means to exalt and strengthen it*. By *Imagination* we here understand the *Representation of an individual Thought*. 'Tis of three kinds: the *first*, joined with Belief of what is to come: the *second*, joined with a Consciousness of what is past: and the *third* regards things present, or as if they were present; for, under this, we comprehend *feigned Imaginations*: as if one should imagine such a Man vested as a Pope; or to have Wings, &c. We single out, for the present, that Species attended with *Faith, or Belief of what is to come*. The Enquiry into this Subject, by *Induction*, is extremely difficult; because the things reported are full of Fables; and new Experiments can, in this Case, hardly be made, but with extreme Caution^o.

*The Power of
Imagination of
three kinds.*

17. The *Power of Imagination* is of three kinds; the *first* upon the Body of the Imaginant; including likewise the Child in the Womb: the *second* is, the Power of it upon inanimate Bodies; as Plants, Wood, Stone, Metal, &c. and, the *third* is, its Power upon the Spirits of Men, and living Creatures. And this last shall be our present Subject.

*Whether strong
Belief has any
Efficacy in pro-
curing the
thing believed.*

18. The Problem is, *whether a Man's constant, and strong Belief, that such a thing shall be; as, that such an one will love him; or that such an one will grant his Request, or the like, has any Force in procuring the thing itself*. And here, again, we must warily distinguish; for 'tis not meant, that this *Belief* should assist, by making a Man more resolute or industrious; in which Case, a constant Belief has a great Effect; as was above observed; but *merely by a secret Operation; as by binding, or changing the Spirit of another*. And here it is hard to make any new Experiment; for *I cannot command my self to believe what I please^p*; and so, no Trial can be made. Nay, 'tis worse; for *whatever a Man imagines doubtingly, or with fear, must needs do hurt;*

^a Might not, therefore, considerable Effects be wrought by working, properly, upon the Imagination? whence, could not this Art be improved and advantageously introduced into Medicine? And *Query*, whether the remarkable *Cures* performed by Operators for Worms in the Gums, Tongue, &c. are not owing to this Cause? See the *Philosophical Transactions*, Numb. 212, &c.

^o The Author, probably, chose to begin this Enquiry, upon account of the great Difficulties wherewith it is attended: according to his Intension, expressed in the Introduction to this Piece of *Sylvia Sylvarum*, and followed in several Instances; as, particularly, in his Enquiry into *Life and Death*, *Winds*, &c. tho he has also a great regard to Utility, in all his Enquiries.

^p This deserves a particular Attention on several Accounts.

but; if Imagination have any Power at all: for a Man oftener represents to himself the things he fears, than the contrary.

19. The only Means is, therefore, to work by another Person in whom Belief may be created, and not by ones self; till one has found, by Experience, that *Imagination prevails*; for then *Experience works Belief in ones self*; if the Belief, that such a thing shall happen, be joined with the Belief that ones Imagination may procure it. For example; I once related to a Man, curious and vain enough in these Matters, that I saw a Juggler, who having a Pack of Cards, would tell another what Card he thought of. My pretended Man of Learning told me, I was mistaken; for, said he, it was not the Knowledge of the Person's Thought; but the enforcing of a Thought upon him, and binding his Imagination by a stronger; so that he could think of no other Card. And thereupon he asked me a Question or two, which I thought he did craftily, as knowing before-hand the usual Feats of the Juggler; and particularly, whether I remembred, if himself told the Card the Man thought; or bid another tell it? I answered, the latter. Whereunto he replied; so I thought: for *himself could not have put on so strong an Imagination*; but by telling the other the Card, who believed that the Juggler could do strange things, the third Man caught a strong Imagination. I hearkened to him, thinking, for a Trifle, he spoke prettily. Then he asked, if I remembred whether the Juggler bid the Man think the Card first, and afterwards told the other, in his Ear, what he should think; or whether he whispered in the Man's Ear who should tell the Card, saying, that *such a Man should think such a Card*; and, after, bid the Man think a Card? I answered, he first whispered the Man in the Ear, that such a Man should think such a Card. Upon this, my learned Gentleman strangely exulted, and pleased himself, saying, *you may see my Opinion is right*: for if the Man had thought first, his Thought had been fixed; but the other imagining first, bound his Thought. Which, tho it did somewhat sink with me, yet I made light of it, and said; *I thought it was Confederacy between the Juggler and the two Servants*: tho, indeed, I had no reason to think so; for they were both my Father's Servants: and the Juggler had never played in the House before. This Juggler also caused a Garter to be held up; and took upon him to know, that such an one should point in such a place of the Garter, as should be so many Inches to the longer End, and so many to the shorter; and still he did it by first telling the *Imaginer*, and afterwards bidding the *Actor* think.

20. This Relation is not here given for its Dignity; but because it opens the nature of the Question; and shews, that *Experiments of Imagination* must be practised upon others, and not upon a Man's self. For there are three Means of fortifying Belief; viz. Experience, Reason, and Authority; the more powerful of which, by much, is Authority: for *Belief upon Reason, or Experience, will stagger*. Authority is of two kinds; Belief in an Art; and Belief in a Man. As for Matters of Belief in an Art; one may exercise them

The Method of working by a second Person, in the Business of Imagination, illustrated by Example.

Three Means of fortifying Belief, viz. Experience, Reason, and Authority.

* Here seems to lie a considerable Secret.

them by ones self; but Belief in a Man, must be by another: therefore, if a Man believe in Astrology, and find a Figure prosperous; or believe in natural Magick; as, that a Ring wore with such a Stone, will do good; this may help his Imagination. BELIEF PLACED IN A MAN IS FAR MORE ACTIVE: yet, ALL AUTHORITY MUST BE FROM ONES SELF, turned either upon an Art, or upon a Man: and *where Authority is from one Man to another, the second must be ignorant, and unlearned, or full of Thoughts*; and such generally are Witches, and superstitious Persons; whose Beliefs, tied to their Teachers and Traditions, are not controlled, either by Reason or Experience: and hence, in *Magick*, they commonly chuse Boys, and young People; whose Spirits easiest take *Belief* and Imagination.

Three Ways of fortifying the Imagination; viz. (1.) by Authority, whence the Belief is derived; (2.) by quickening, and corroborating the Imagination; and, (3.) by repeating, and refreshing it. The Business of
viz. (1.) Authority has been spoke to already: and for the Means of quickening and
By Authority. corroborating the Imagination; we see what is used in Magick (if in such
(2.) Practices there be any thing purely natural;) viz. Vestments, Characters,
Quickening the Words, Seals; certain Parts of Plants, or Animals; Stones; Choice of the
Imagination. Hour; Gestures, and Motions; Incenses, and Odours; Choice of Society,
which increases Imagination; Diets, and Preparations for some time before-
hand. And, for Words; there have been always, either barbarous ones,
and of no Signification, lest they should disturb the Imagination; or Words
of Similitude, to second and feed it: and this, as well in heathen Charms,
as those of later times[†]. They also use Scripture Words; for the Belief that
religious Texts, and Words, have Power, may strengthen the Imagination. And,
for the same reason, Hebrew Words, which, with us, are accounted more holy
and mystical, are often used for this purpose[‡]. For refreshing the Imagina-
And, (3.) tion; which is the third Means of exalting it; we see the Practices of Ma-
refreshing it. gick, in Images of Wax, and the like, that are to melt by degrees; and
some other things buried, to putrefy gradually in the Earth: for as often as
the Imaginant thinks of these things, so often does he represent to his Imagination
the effect desired.

How the Imagination may physically operate to great Distances. 22. *If there be any Power in Imagination, 'tis less credible it should be so incorporeal and immaterial a Virtue, as to operate at great Distances; though*

[†] These Particulars seem deduced with great strength of Judgment; and lay a solid Foundation for a noble Practice, especially in the Business of Education; whereby Men might surely be formed to much greater Advantage than in our present Methods. The Education of the Chinese may be worth enquiring into upon this Occasion.

[‡] Observe, the Author has not forgot his own Caution of guarding the Infancy of Philosophy against Fables, Fancies, and Fictions; tho, he judges, that all superstitious Ceremonies should be carefully examined, after Philosophy has gathered Strength; and, therefore, all along takes care to sow the Seeds of such Enquiries, that they may be farther cultivated, in future Ages.

[§] It may deserve enquiring, how many of these Particulars have been introduced, and with what Alterations, and Success, into false Religions. Are not Relicks, Images, Incense, horary Masses, certain Gesticulations, Probations, and some particular Words, and Phrases, things of this Stamp?

through all Mediums ; or upon all Bodies : tho it is required, that the Distance be competent ; the Medium not contrary ; and the Body apt and proportionate. Therefore, *if there be any Operation upon Bodies absent by Nature*, 'tis likely to be conveyed from Man to Man, as *Fame* is : so, for example, if a Witch, by Imagination, should hurt any one a far off, it cannot be naturally ; but by working upon the Spirit of one that comes to the Witch ; and from thence upon the Imagination of another ; and so another ; till it arrive at the Person intended. And altho they say it suffices to take a Pin, or a Piece of the Garment, or the Name of the Party, &c. little Credit can be given to such things ; *unless it be by the working of evil Spirits* *.

23. The Experiments that *certainly* demonstrate the Power of the Imagination upon other Bodies, are few, or none : for the *Experiments of Witchcraft* are no clear Proofs ; because they may be by the tacit Operation of evil Spirits. We are therefore obliged, in this Enquiry, to use new Experiments ; wherein, however, we can furnish only Directions, and not any positive Trials. For, indeed, we give so little Credit to *these Effects of Imagination upon other Bodies*, that we shall only try them at leisure : but, in the mean time, are willing to lead others the way.

24. (1.) To work by the Imagination of another, 'tis necessary that he, by whom you work, should have an *Opinion of you* ; as, that you can do strange things ; or are a *Man of Art*, as they call it : otherwise, the simple Affirmation to another, that this or that shall be, makes but a weak Impression on his *Imagination*. And, as we cannot fully discern the Strength of *Imagination* in one Man more than another, it were proper to try the *Imaginations* of several ; in order to light upon a strong one : as if a Physician should tell three or four of his Patient's Servants, that their Master would certainly recover *.

25. (2.) The Minds of Men are so various, that the Imagination of him you would use, cannot be always alike constant and strong ; and if the Success follow not speedily, the Operation will languish. To remedy this, you must pretend to him whose Imagination you use, several degrees of Means by which you operate ; as to order him, every three Days, if he find not the Success apparent, to use another Root, part of a Beast, or Ring, &c. as being of more Force ; and if that fail, another ; and if that, another ; till *seven times*. You must also prescribe a good length of Time, for the promised Effect ; as to tell the Servant his Master shall recover ; but it will be *fourteen Days* before he finds it apparently, &c. All this, to entertain the *Imagination*, that it waver less.

26. (3.) 'Tis certain, that Potions, or things taken into the Body ; Incenses and Perfumes received at the Nostrils ; and anointing of some Parts, natu-

* If once *evil Spirits* are admitted, there is an End of *strict philosophical Enquiry* ; and the Cause is removed to a different Court. See the *De Augmentis Scientiarum*, Sect. XXVIII.

† If there be no Immorality, Trespas upon Religion, Sense, good Manners, or Conscience, in such a Procedure, where is the Harm of trying it ? See below, § 27.

naturally work upon the Imagination of him who uses them : therefore it must needs greatly co-operate with the Imagination of him you use, to prescribe him, before he enters upon the Receipt, for the Work he desires, such a Pill ; or a Spoonful of Liquor ; to burn such an Incense ; or anoint his Temples, or the Soles of his Feet, with such an Oil or Ointment : and you must chuse, for the Composition of such Pills, Perfumes, or Ointments, Ingredients that make the Spirits a little more gross, or thick ; whereby the *Imagination* will fix the better ^w.

(4.) By a proper choice of Times. 27. (4.) The *Body to be wrought upon, is better affected at some certain times, than at others* ; as if you should order a Servant, whom you have possessed that his Master shall recover, to use such a Root, or such a Root ; when his Master is fast asleep : for Imagination is likely to operate better upon Men asleep than awake ; as appears by Dreams^x. In the *Art of Memory*, visible Images work better than other Conceits : thus, if you would remember the Word *Philosophy*, you shall better do it by *imagining*, that such a Man (*for Men are the best Places*) is reading upon *Aristotle's Physicks* ; than by *imagining* one to say, *I'll go study Philosophy*. This Observation, therefore, should be transferred to the present Subject : *for the clearer the Imagination is, the better it fills and fixes*. Whence, probably, the *Experiment of binding Mens Thoughts* will prove less fallacious, upon telling a Person, that another shall name *one of twenty Men*, than *one of twenty Cards*^y. And this *Experiment of binding the Thoughts*, should be diversified ; and tried to the full : observing whether it succeed for the most part, tho not always.

(5.) By operating upon the weakest Passions. 28. (5.) 'Tis proper to consider, upon what things the Imagination has greatest Force : and the Rule is, that *it operates most upon those things which have the lightest and easiest Motions* ; and therefore, principally upon the Spirits of Men : and those Affections that move the lightest ; as in *procuring Love* ; and *binding Lust* : which Passions are always attended with *Imagination* of Fear, Irresolution, and the like. Whatever is of this kind should be thoroughly enquired into.

(6.) The Enquiry to be extended to Plants, and other Matters susceptible of light Motions. 29. (6.) Diligent Trials should likewise be made upon Plants : as if you should tell a Man that such a Tree will die this year ; and require him, at certain times, to go and see how it fares. As for inanimate things ; 'tis true, the Motion in shuffling of Cards, or throwing of Dice, is light : and there is a Folly very usual with Gamesters, to imagine some By-standers bring them Ill-luck. Trial also should be made, of holding a Ring by a Thread in a Drinking-Glass, and, before-hand, telling him who holds it, that it shall strike so many times against the Side of the Glass, and no more ; or of holding a Key between two Mens Fingers, without a Charm ; and to tell those

^w This Direction appears to be derived from the reputed Practices of Witches and Sorcerers : yet seems to have a good Foundation in Nature and Medicine. Both the ancient and modern Writers abound with the Names of Ingredients for this Purpose ; but their Natures are not sufficiently understood.

^x For the Doctrine of Dreams, see the *De Augmentis Scientiarum*, Sect. VIII. See also, the Author's *Essay on Prophecies*.

^y See above §. 18.

those who hold it, that at such a Name it shall turn off their Fingers ^z: for these two are extreme light Motions. And tho I have no Opinion of these things, yet so much I conceive to be true; that *strong Imagination* has more Force upon living Things, or which have been living, than upon Things merely inanimate: and again, more Force upon light and subtile Motions, than upon such as are vehement, or in a ponderous Subject.

30. 'Tis an usual Observation, that if the Body of one murdered, be brought before the Murderer, the Wounds will bleed a-fresh. Some affirm, that a dead Body, upon the Presence of the Murderer, has opened the Eyes; and that there have been such Motions, as well when the Parties murdered were strangled, or drowned, as when they were killed by Wounds. And, *if this be natural*, it must be referred to *Imagination* ^a. So the *tying of the Point* upon the Day of Marriage, to make Men impotent, must, *if natural*, be referred to the *Imagination* of him that *ties* it. I conceive this to have the less Affinity with Witchcraft, because not only particular Persons, as Witches; but any other Person may do it ^b. See the next *Article* IMPOTENCY. See also the *Articles* SPIRITS, and SYMPATHY.

The Notion of a dead Body bleeding at the approach of the Murderer.

IMPOTENCY.

In *Zant*, 'tis very common to make Men impotent: the like is practised in *Gascony*; and always upon the Wedding-day. But in *Zant*, the Mothers themselves do it, by way of Prevention; because they thereby hinder others Charms, and can undo their own. 'Tis a thing the *Civil Law* takes cognizance of; and therefore of no small moment ^c. See the *Articles* IMAGINATION, and SYMPATHY.

Impotency by Ligature, or tying of the Point.

IMPULSE, or MOTION.

1. A ponderous Body put into Motion, is more easily impelled, than

P 2

when *The Nature of Impulse and Percussion.*

^z These Particulars are derived from the common superstitious Practices of *discovering a Thief*, &c. As by the *Sieve and Sheers*; the *Common-Prayer Book and Key*, &c. in which some People have great Faith.

^a How is this to be understood? Is it possible the Imagination of the guilty Person, can be so far wrought upon by Prepossession, strong Belief, or consciousness of Guilt, as to make Blood flow from a Carcass, or open the Eyes of the Dead? The Author might well call this a *difficult Enquiry*, where it is so extremely difficult for the *Reason* to keep pace with the *Imagination*, and not be foiled by it. But to keep our *Reason* and *Judgment* clear, he prudently directs us to work with the *Imagination* of another.

^b Some entire Parts of this general Enquiry remain unprosecuted by the Author; as how the *Fetus* comes to be marked in the *Uterus*, &c. and the Part he touches upon, is not yet driven to any tolerable degree of Certainty and Precision; tho a thing of great Importance. And to consider the general Procedure of Men, we shall not find it strange, that no farther Discoveries are made in this, and the like Subjects: for the modern Method has usually been, to turn *Enquiries* into *Disputes*; and instead of pursuing Nature close, by new Experiments, the Chase has been deserted; and dwindled into single Combats, Opinions, and Parties: Men thus affecting Victory over one another, more than over *Nature*.

^c For the *History* of this Affair, consult Mr. *Chambers's Dictionary of Arts and Sciences*; under the *Article* LIGATURE.

when at Rest ^d; partly because Motion *discusses the Torpor* ^e of solid Bodies; which, beside their Motion of Gravity, have a natural Appetite not to move at all ^f; and partly, because a Body at rest, acquires, by the Resistance of the Body whereon it rests, a stronger compression of Parts, than it has of itself; and therefore requires more Force to put it in Motion: for if a heavy Body be suspended by a Thread; Percussion will give an Impulse very near as easily, as if it were already in Motion ^g.

Impulse requires Resistance, or Weights in the moving Body.

2. A Body too large, or too small, cannot be thrown so far as a Body of a middle size: so that there must be a Proportion between the Body moved, and the Force to move it strongly; for *Impulse* requires, not only Force in the moving Body, but Resistance in the Body moved ^h: if the Body be too great, it yields too little; and if too small, it resists too little ⁱ.

The Cause of Impulse.

3. 'Tis found in common Experience, that no weight has so much Force, when laid upon a Body, as by falling from on high. I take the chief *Cause* to be, that the Parts of the Body moved, have, by *Impulse*, or the *Motion of Gravity continued*, a Compression in them, as well downwards, as when they are thrown, or shot thro' the Air forwards. I conceive also, that the *Quickness* of this Motion gains upon the Resistance of the Body below: for priority of Force is always of great Efficacy; as appears from numerous *Instances* ^k. See the *Articles*, GRAVITY, and MOTION.

I N C O R P O R A T I O N.

The Incorporation of Powders, and Liquors.

Most Powders, as Meal, &c. grow closer, and more coherent, by the admixture of Water, than of Oil; tho' Oil be the thicker Body. The *Reason* is, from the Congruity of Bodies; which, if greater, makes a perfecter

^d This expresses a Part of Sir Isaac Newton's second Law of Motion; viz. that the *Alteration of Motion* is always proportionate to the moving Force impressed.

^e Viz. Overcomes their Force of Resistance.

^f This Sir Isaac Newton expresses by the *Vis Inertia*, or Force of Inactivity in Matter.

^g Here is a great Opening into the modern Doctrine of Motion, in general; and with regard to the Doctrine of Friction, in particular. See *Memoires de l'Academie Royale des Sciences*, *passim*.

^h See Sir Isaac Newton's *Axiomata*, or *Leges Motus*; in his *Philosophie Naturalis Principia Mathematica*.

ⁱ 'Tis plain the Author means by *Impulse*, the same that we now commonly call *Momentum*; or, in mathematical Language, a *Rectangle of the Velocity into the Weight of the Body*: so that the Sense is, that in order to a great Stroke, or *Impulse*, the Body must have a Weight proportionable to its Velocity. It will, doubtless, seem strange to many, that the Author should, a hundred Years ago, have seen so far into what are generally reputed *modern Doctrines*, and *Discoveries*. But the Way he came at them, was, by conversing with Nature; a Way that lies open to every one's Diligence.

^j Is not here a direct Intimation of what Sir Isaac Newton at first casually observed, as to the *Power of Gravity*, and afterwards deduced; till, at length, he discovered this *Power* to be the *Cause* that keeps the Planets and Comets in their Orbs, &c? See Dr. Pemberton's *Introduction* to his *View of Sir Isaac Newton's Philosophy*.

^k How does this comport with Sir Isaac Newton's third Law of Motion; viz. that *Action* and *Re-action* are always equal? It is a curious Speculation, and may deserve to be still farther prosecuted by Experiment. See the *French Memoirs*, *passim*.

feeter Imbibition and Incorporation : and this Congruity, in most Powders, is greater betwixt most Powders and Water, than betwixt Powders and Oils : but Adhes, and Painters-Colours ground, incorporate better with Oil¹. See the *Articles*, METALS, and MIXTURE.

INDURATION, or PETREFACTION.

1. *Induration*, or *Petrefaction* of soft Substances, are great *Alterations* in Nature : and effected by three Means ; viz. (1.) by *Cold* ; which has a Property of *Condensing* : (2.) by *Heat* ; which is not a proper, but a consequential Effect : for Heat attenuates ; and, by Attenuation, drives out the Spirit, and moiſter Part of a Body ; whereupon the more groſs of the tangible Parts, contract and shrink together ; both to avoid a *Vacuity*, as they call it ; and alſo, to defend themſelves againſt the Force of Fire, which they had ſuſtained. (3.) The third means is, by *Aſſimilation* ; when a hard Body aſſimilates a ſoft one contiguous to it.

Three Means
of Induration,
or Petrefac-
tion in Bodies ;
viz.

(1.) Cold.
(2.) Heat.
And, (3.)
Aſſimilation.

2. The Examples of *Induration* are many ; as the Generation of Stones within the Earth ; which, at firſt, are but rude Matter, or Clay : and ſo *Mine-rals* ; which were originally Juices, concrete and harden^m. We have other *Iſtances* in the making of Brick, Tile, and Glaſs ; in the Exudations of Cryſtal, and Rock-Diamonds, which harden with Timeⁿ ; the Induration of Amber, which, at firſt is a ſoft Substance^o, &c.

Iſtances of
Induration.

3. As to *Indurations by Cold*, there are few Trials of it ; for we have no intense Cold, here on the Surface of the Earth, ſo near the Sun. The likeſt Trials are thoſe by means of Snow and Ice : for theſe Bodies, eſpecially when their Cold is actuated by *Nitre* or *Salt*, will ſoon turn Water into Ice ; and may, perhaps, turn Wood, or ſtiff Clay, to Stone, in a longer time^p. Let therefore, a Piece of Wood, or tough Clay, be laid in a Conſervatory of Snow, or Ice, with the Addition of ſome Quantity of *Nitre* ; and let it lie for a Month, or longer^q.

Trials recom-
mended for In-
duration.

(1.)
By direct Cold.

4. An-

¹ A conſiderable part of *praſtical Philoſophy* depends upon the right underſtanding of the Ways of incorporating and mixing of Bodies. *Pharmacy*, in particular, has a great Dependence upon it : ſo have *Chemistry*, and many other Arts ; eſpecially where Cements are concerned. But ſcarce any conſiderable Discoveries can be made in this Affair, without particular Sets of Experiments ; whereby Bodies may be ranged into Claſſes, according to the Congruity, or Incongruity they have to each other ; with regard to Incorporation, Mixture, and Union. And ſomething of this kind is begun by Monſ. *Geoffroy*, in the *French Memoirs* ; and Dr. *Stahl*, in his *Specimen Beccherianum*, &c. Sir *Iſaac Newton* likewise, delivers ſome uſeful Hints to this purpoſe ; both in his *Opticks*, and *Principia*.

^m See Mr. *Boyle's Treatiſe of the Origin and Virtues of Gems* ; where this Point appears illuſtrated, and proved by a variety of *Iſtances*.

ⁿ See Mr. *Boyle*, in the Piece juſt mentioned.

^o See various *Iſtances* in Confirmation hereof, in the *Philoſophical Tranſactions*.

^p Are there any direct *Iſtances* of ſuch a Conversion ? If there are, they ſhould be diligently collected, as *capital Things* that lead far into the Regions of Nature ; and tend to enlarge the Power of Art. See Mr. *Boyle's Hiſtory of Cold* ; the *Philoſophical Tranſactions* ; and the *French Memoirs*.

^q See Mr. *Boyle's Hiſtory of Cold* ; and his *Memoirs for a general Hiſtory of the Air*.

(2.)
By metallic
Waters.

4. Another Trial may be made by means of *metallic Waters*; which have a *virtual Cold*. Put therefore, Wood, or Clay, into *Smithy-Water*; or other metallic Waters; to see whether the Matter will harden, in some reasonable time. But this, I mean, of such metallic Waters as are made by washing, or quenching; and not the *Aqua Fortes*, made by Dissolution: for these latter are too corrosive to consolidate †.

(3.)
By natural
Springs, and
other Waters.

5. There are some natural *Spring-waters*, that will *petrefy Wood* †; so that in one Piece of Wood, the Part that was above the Water, shall continue Wood; and that Part under the Water, be turned into Stone †. Probably, such petrefying Waters are some metallic Mixture; but a more particular Enquiry should be made into them. 'Tis certain, that an Egg was found at the Bottom of a Moat, where, having lain many Years, the Earth had somewhat overgrown it; and this Egg was come to the hardness of a Stone; had the Colours of the White and Yolk, perfect; and the Shell shining in small Grains, like Sugar, or Alabaster. Another certain, and tried Experiment there is, of *Induration by Cold*; viz. that even Metals are hardened by often heating, and quenching them in cold Water †: for *Cold always works most powerfully when Heat has preceded* †.

Trials for In-
duration, by
Heat. †

5. For *Induration by Heat*; it must be considered, (1.) that Heat, by exhaling the moiſter Parts, either hardens the Body, as in Bricks, Tiles, &c. or (2.) if the Heat be more fierce, it makes the groſſer Part itself run and melt; as in making ordinary Glaſs; and the Vitriſication of certain Earths and Metals. In the *former* Caſe, which is hardening, by baking, without melting; the Heat firſt indurates; then makes the Matter fragile; and laſtly, incinerates and calcines it. But to make an *Induration with Toughneſs*, and leſs Fragility, a middle way ſhould be taken. For Example; let the Bodies be boiled in Water for two or three Days; but then they muſt be ſuch as the Water will not enter; as Stone; and Metal: otherwiſe, long boiling will rather ſoften than indurate them; as has been tried in Eggs, &c. therefore *ſofter Bodies* may be put into Bottles; and the Bottles hung in boiling Water, with the Mouths open above the Water, that no Liquor may get in; for by this means the *virtual Heat* of the Water will enter, without

† This Experiment appears to be well deduced, and intended: but I do not recollect its being tried. Perhaps it had better be tried with ſoft Wood, than Clay; becauſe Clay, unleſs it be firſt baked or hardened, is apt to diſſolve in Water: and, I ſuſpect, the Conſolidation here intended, is rather by *Appoſition* than *Alteration*, or *Conversion*. See below, § 7.

† For Inſtances of this Faſt ſee the *Philoſophical Tranſactions*.

† Is not this a proper Tranſmutation: or what was *Wood* before, in the Judgment of the Senſes, and all other Trials, now become *Stone*; in the like Judgment of the Senſes, and all other Trials? And is not the Alteration effected by ſimple Appoſition; or ſome *ſtony* or *petreſcent Matter* entering into the Pores of the Wood; without otherwiſe *changing the internal Form* or *Texture* of the proper Fibres of the Wood? 'Tis of conſiderable conſequence, to have a juſt, and clear Underſtanding in this Matter.

† See Mr. Boyle on Colours, in *Initio*.

† This may prove an excellent Rule, in many Caſes of Practice.

without making the Body adust, or fragile ; whilst the substance of the Water is excluded *.

6. We made Trial with a Piece of *Free-stone*, and with *Pewter* ; put into the Water at large. The *Free-stone*, we found, received some Water ; for it was softer, and easier to scrape than a Piece of the same Stone kept dry : but the *Pewter*, into which no Water could enter, became more white, (like to Silver) and less flexible, by much.

On Stone, and Pewter.

7. There were also put into an earthen Bottle, placed as before, a *Pellet of Clay*, a *Piece of Cheese*, a *Piece of Chalk*, and a *Piece of Free-stone*. The *Clay* came out almost as hard as Stone ; the *Cheese* likewise very hard, and not well to be cut ; and the *Chalk*, and *Free-stone*, much harder than they were. The Colour of the *Clay* inclined not to the Colour of *Brick* ; but, rather, to White ; as in ordinary Drying by the Sun. These Experiments were made by boiling upon a strong Fire, and supplying the Water, as it consumed, with other hot Water ; but the boiling was continued for *twelve Hours only* : and, probably, the Effect would have been more considerable, had the Operation lasted two or three Days *.

On Clay, Cheese, and Chalk.

8. As for *Affimilation* ; of which there is some degree, even in Bodies inanimate ; we see Examples of it in some *Clay Grounds*, where Pebbles are often found in a Lump together, with a Crust of Cement, or Stone, between them, as hard as the Pebbles themselves : and it were proper to try, by putting *Pebble-Stones into Clay*, whether, in time, the Clay would not become harder than part of the same Lump, in which no Pebbles were set. We see in Ruins of old Walls, the Mortar will become as hard as the Brick : We see also, that the insides of Wine-Vessels gather a Crust of Tartar, harder than the Wood itself : and Scales likewise grow to the Teeth, harder than the Teeth themselves †. But *Induration by Affimilation*, principally appears in the Bodies of Trees, and living Creatures : for no Nourishment that the Tree, or Animal, receives, is so hard as Wood, Bone, or Horn, &c. but is thus indurated by Affimilation ‡.

I N-

* This Operation is what the Chemists call a *Bath-heat*, or working in *Balneo Maria* : which, tho an obvious and common Contrivance, does not appear to have been yet employed to many considerable Purposes, where it might be highly useful ; and that, in what is called *Natural or Experimental Philosophy*, as well as direct *Chemistry* : particularly, in making out the extensive History of *Jellies*, *Mucilages*, and *Glews* ; into which kind of Matter all animal Substances are resolvable, and of which they were, *perhaps*, originally formed. At least, this Enquiry appears of some Importance ; and should be extended to the *Vegetable Kingdom* ; if not, also, to the *Mineral* : where, should the common *Balneum* prove too weak, the *Digestor* may take place.

† These Experiments, therefore, should be farther prosecuted.

‡ In what respect is *Tartar* harder than *Wood*, and the *Scales* of the *Teeth* harder than the *Teeth* ? is it in being more Brittle ? or, is *Glass* properly said to be harder than *Wood* ? This may only depend upon the arbitrary Signification of Words ; but 'tis proper to use a *philosophical Language* in *philosophical Subjects*. Mr. *Locke*, in his *Essay upon human Understanding*, has endeavoured to settle this Point.

§ Here seems to be a Necessity, not only for exactness of Language, but also for farther Enquiry ; because, possibly, the component Particles of Fluids, may be Solids. See Mr. *Boyle*, on the *Origin of Forms*, *Fluidity*, and *Firmness*, &c. And let Trial be made, whether certain Solids, by reducing them to extremely fine Parts, will not put on the Appearance, and exhibit all the *Phænomena*, of Fluids.

INFECTION.

Infectious Diseases classed.

Some known Diseases are infectious ; and others not. The infectious are, (1.) such as lie chiefly in the Spirits, and not so much in the Humours ; and therefore pass easily from Body to Body : as Pestilences, Lippitudes, and the like. (2.) Such as taint the Breath, which passes manifestly from Man to Man ; and not invisibly, as the Spirits do : Distempers of this kind are Consumptions of the Lungs, &c. (3.) Such as come out at the Skin, and taint the Air, or Bodies adjacent ; especially if they consist in an unctuous Substance, not apt to dissipate ; as the Itch, and the Leprosy. (4.) Such as are seated merely in the Humours, and not in the Spirits, Breath, or Exhalations : whence they never infect but by Contact ; and such a Contact as comes within the *Epidermis* ; viz. the Venereal Disease, the Bite of a mad Dog^a, &c. See the *Articles*, ODOURS, PLAGUE, and POISONS.

INFUSION.

The ways of making accurate Infusions ; viz.

By short continuance, and renewal of the Subject.

1. The Rule for the Infusion of Bodies containing fine Spirits, which easily dissipate, is, that a short Continuance gets out the Spirit, but a longer confounds it ; as extracting also the earthy part, which debases the finer^b. It is therefore an Error in Physicians, to rest simply upon length of time, for increasing the Virtues of Tinctures and Infusions. But if you desire a strong Infusion of Bodies that have fine Spirits ; the Way is, not to allow longer time ; but to repeat the Infusion oftener. For Example ; infuse a Pugil of Violets in a Quart of Vinegar, for three quarters of an Hour ; then take them out, and refresh the Infusion with a like Quantity of new Violets, seven times ; and it will make the Vinegar so fresh and strong of the Flower, as to continue perfect for a Year : and indeed it smells better of the Flower a good while after, than at first^c.

2. The

^a There seems to be wanting, a strict *inductive Enquiry* into the Business of Infection ; to shew whether (1.) any Distempers are properly infectious ; (2.) which those Distempers are ; and, (3.) the Means of guarding against them. Are the Plague, the Small-Pox, the Itch, &c. strictly and properly catching ; or, communicative from Person to Person, without immediate Contact ? May there not be some general Cause, as particular Dispositions of Air, &c. capable of giving the same Distemper to several People at once, or in sequence ? Perhaps these things have not been so thoroughly examined, as to persuade a cautious Man to speak definitively, and positively about Diseases, on either side of the Question. The late Writings upon the Subject of the Plague at *Marseilles*, may deserve to be consulted upon this Occasion ; and compared with the former Writers upon contagious Diseases. See also Mr. Boyle, and the *Philosophical Transactions* : Tho we have greater Expectations from new Sets of accurate Experiments, directly calculated for discovering the Causes of Diseases. But this Method of Enquiry, however fully described by our Author in his *Novum Organum* ; and exemplified in his own particular Histories, especially in that of *Life and Death* ; seems to be little practised.

^b This is an admirable Rule, and deserves the particular Attention of Physicians, Chemists, and Apothecaries.

^c But how will it be with regard to Colour ? Perhaps the Curious may find something here they did not expect.

2. The same *Rule* is of singular Use in the Preparation of Medicines, and other Infusions. Thus the Leaf of *Borrage* has an excellent Spirit, to repress Melancholy, Vapours, and cure Madnes^a; yet, if infused long, it yields only a *raw Substance*, of no Virtue: but, perhaps, if the *Borrage* remain a little in new Wine, or Beer while it works, before it is tunned, and be often changed for fresh; it will make a sovereign Drink against Melancholy. Understand the like of Orange-Flowers.

The same Rule applicable in Medicine.

3. *Rhubarb* contains Parts, of contrary Operations; viz. some that purge, and others that bind the Body: the first lie looser, and the latter deeper in the Root; so that if *Rhubarb* be infused for an Hour, and well squeezed, it will purge more, and, after the Operation, bind the Body less, than if it stood for twenty-four Hours^c: and, I conceive likewise, that by adding fresh *Rhubarb* several times, at small Intervals, still taking away the former, it may be made as strongly purgative as Scammony^e. And it is no small Secret in Physick, to make *Rhubarb*, and other kindly Medicines, purge as powerfully as those that are not without some Malignity^d.

Particularly in the preparing the Tincture of Rhubarb.

4. The Virtue of purgative Medicines generally consists in a fine Spirit; for they lose greatly of their Efficacy by boiling. It is therefore of good Use in Physick, to retain the purging Virtue, yet take away the unpleasant Taste of Purgatives; which, perhaps, may be done by this Course of Infusions, quick repeated: for, it is probable, that the horrid and odious Taste of these Medicines, proceeds from their grosser Parts.

That the Virtues of Purgatives reside in their Spirit.

5. Generally, the working by Infusions, is gross and blind; unless it be known, which of the several Parts of the Body will soonest come out; and which more slowly: and so, by suiting the time, to take and leave the Quality desired. To find this there are two Ways: the one is, to try what a long, and what a short stay will effect; the other, to try several Infusions of the same Body, successively. For example; take *Orange-Peel*, *Rosemary*, or *Cinnamon*, and let them infuse half an Hour in Water; then take them out, and infuse them again in other Water; and so the third time: and you will find the several Liquors different, not only in Strength and Weakness: but also in Taste or Odour: for, possibly, the first Wa-

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ter

^a Is this found to answer, upon Experience?

^c Here is a great and gainful Secret intimated: for by this Means any kind of Flavour may at pleasure be given to Wines; so as, even in Countries that have no Vines, to imitate and exceed the Colours, Flavours, and Richness of any natural Wine of foreign Growth. Those who please, may easily try the Experiment, with the fresh and green Leaves of *Baulm*; which give a Flavour, in some Judgments, approaching to that of the genuine *Frontignac*. See the Article SUGAR.

^d Let this be tried, for the Thing may well deserve it.

^e This also deserves to be tried to the full.

^b This is more than a bare Conjecture; and may, possibly, be a Direction, even to those, who have wholly applied to Physick and Pharmacy. Let the common Dispensatory Catharticks be examined by this Rule.

^f Here seems to be an excellent Lecture for Physicians, Apothecaries, and Chemists; tending to shew us, what considerable Discoveries may be made in these Arts, by proper Experiments, and a close Attention to Nature.

ter will have more of the Scent; and the second more of the Taste ^k, &c.

Infusions in Air, similar to those in Water.

6. *Infusions in Air*, or ODOURS^l, have the same Diversities with *Infusions in Water*; as several Odours issue at several times from one Flower. For Example; Violets, Woodbines, Strawberries, &c. yield a pleasing Scent, at first, whilst they are fresh; but soon after one that is ungrateful, and differing from the former: which, may proceed from the grosser Spirit coming out the latest ^m.

How to discharge the Spirits of Bodies in some Cases.

7. As we may desire to extract the *finest Spirits* in some Cases; so we may desire to discharge them as hurtful in others. Thus *Wine* burnt, is less inflammatory than unburnt; by reason that the *finer Spirit*, is evaporated in the Operation: whence burnt-Wine becomes more proper in Fevers. *Opium* loses its poisonous quality, by being dissolved with Brandy, and exhaled. *Senna* loses of its Windiness by boiling: and generally subtle Spirits are taken off by Evaporation. And in making Infusions of Things, that have too high a Spirit; it were better to pour off the first Tincture, after a little time, and use the latter ⁿ.

I N S E C T S.

Advantages of the Enquiry into the Nature of Vivification.

1. The *Nature of Vivification* is well worth the Enquiry: and as the Nature of Things is commonly perceived better in small, than in great; and in imperfect, than in perfect, and in parts than in wholes; so the *Nature of Vivification* is best sought in Creatures bred of Putrefaction^o. The Advantages of this Enquiry are considerable, and tend (1.) to disclose the Origin of Vivification; (2.) the Origin of Figuration; (3.) many Things in the Nature of perfect Creatures, which here lie more secret: and (4.) to transfer, in the way of Operation, some Observations on Insects, to produce Effects upon perfect Creatures. The word *Insect*, indeed, does not suit the Subject:

^k There are great Secrets couched here; which Men must remain ignorant of, if they will not go upon Experiments.

^l Observe the Expression, *Infusions in Air*, or Odours: for are not Odours made by the subtle Effluvia of the odoriferous Body, impregnating the Air, as a general *Menstruum*; in much the same manner, as *Water* is impregnated by the subtle Parts of *tinging Bodies*, in fine Tinctures, or Infusions? And indeed, is not the whole Atmosphere, one vast Ocean of Air, impregnated with Millions of different kinds of Particles, so as to be, strictly and properly, an universal *Solvent* or *Menstruum*? Mr. Boyle, Dr. Hæck, &c. have, perhaps, shewn this to be no Philosophical Fiction.

^m See this Doctrine pursued in Boerhaave's Chemistry, under the *Processus* upon Vegetables.

ⁿ The Enquiry here begun, so much imports the Improvement of *Medicine* and *Pharmacy*, that 'tis great Pity it should not be continued, by a Collection of capital Instances, and Deductions; that, at length, we might have some tolerable certainty in these Arts, which, at present, lye almost uncultivated, with regard to useful Purposes, and solid Advantages. The *Pharmacopœia* of the Royal College of Physicians at Edinburgh, seems to have set a noble Example in this way.

^o It has not perhaps been hitherto satisfactorily shewn, that any Creature is directly bred from Putrefaction; without the Interposition of Eggs or *Animalcula*. What are the fittest Experiments, or crucial Instances, to determine this Point?

Subject : but we use it, for Brevity, to denote *only Creatures bred of Putrefaction.*

2. *Insects* are bred out of several Matters^p; some out of *Mud* or *Dung*; *Instances of the breeding of Insects, viz.* as *Earth-worms, Eels, Snakes, &c.* both being Putrefactions: for Water putrefies in Mud, as not able to preserve itself: and all Excrements are the refuse and putrefactions of Nourishment^q. Some breed in Wood, both *Woodlice.* growing and cut down; and at certain Seasons. *Millepedes* or *Woodlice*, which roll themselves into Balls, are bred chiefly under Logs of Timber, but not in the Timber; and they are said to be found also in Gardens, where no Logs are. But it shou'd seem that their Generation requires a shelter, both from Sun, and Rain, or Dew; as Timber is: and *therefore they are not venomous*^r; but held by Physicians to purify the Blood.

3. 'Tis observed also, that *Bugs* are found in the Chinks and Crevices of *Bugs.* Bedsteads. Some Vermin breed in the Hair of Animals: as Lice and Ticks; which rise from the Sweat kept close, and somewhat dry'd by the Hair^t. The Excrements of living Creatures, not only breed Insects, when they are voided, but also whilst in the Body; as Worms, whereto Children *Worms:* are subject, breed chiefly in the Guts^u. And in many pestilential Diseases, *Worms* are found in the upper parts of the Body, where Excrements are not; but only putrefied Humours.

4. *Fleas* breed principally in Straw, or Mats, where there has been a little Moisture, or the Chamber and Bed-straw been kept close, and not air'd^v. 'Tis said they are kill'd by strewing of Wormwood in the Room^w. And indeed bitter Things are apt rather to kill, than engender Putrefaction; as Things fat or sweet, are aptest to putrefy.

5. There is a *Worm* that breeds in Meal, like a large white *Mag-* *Worms in* got; which is given as a dainty to Nightingales. The *Moth* breeds *Meal.* upon Cloth, and Woollen, especially if laid up damp and wet: it de- *Moths, and lights Weevils;*

Q 2

^p It might be safer, to say that *Insects breed in*, rather than that *they are bred out of several Matters*; which seems presuming too much upon a Knowledge of the Cause, before it is certainly found: whereas the business is to express the Phænomena, so as to leave the Enquiry free and open; till the Cause can be fairly discovered by future Experiments, or a proper Induction.

^q The Business of Putrefaction, in different Subjects, has by no means been well prosecuted by particular Enquiries, Instances and Experiments; which, properly pursued, might lay open a very important Scene, and give us more Light into the secret Works and Operations of Nature, than could be expected from some seemingly more honourable and grand Enquiries. See the Notes upon the Article GENERATION.

^r What are the Premises of this Consequence? It seems to intimate, that the *Venom in Animals*, proceeds from their being exposed to the Sun, Rain, and Dew. Let the Fact be farther examined.

^t If this be understood of the Matter, wherein they are bred, and whereby they are nourished and increased in Bulk, it may, perhaps, be allow'd without begging the Question, as 'tis called; or presuming too much upon the Issue of the Enquiry.

^u See M. Andry on the Subject of Worms, and the Philosophical Transactions.

^v For the Generation and Formation of Fleas, see a Paper in the Philosophical Transactions, N^o 249. See also Dr. Hock's Micrographia, and Dr. Power's Experiments.

^w The good Housewives have here found a Cure, without directly knowing the Cause; viz. frequent washing the Room, and Cleanliness.

lights to be about the Flame of a Candle. There is a *Worm* call'd a *Weevil*, bred under Ground, that feeds upon Roots; as Parsnips, Carrots, &c.

*Water Insects
and the
Gad-fly.*

6. Some *Insects* breed in standing Waters, especially if shaded; as the *Water-Spider with six Legs*. The *Gad-fly* breeds in somewhat on the top of the Water, and harbours chiefly about Ponds.

*The Worm in
Wine-Lees,
and Snow.*

7. There is a *Worm* bred in decay'd *Wine-Lees*; that afterwards turns to a *Gnat* *. It has been anciently observed, that a *Worm* breeds in old Snow; and is of a reddish Colour, dull of Motion, and dies soon after it leaves the Snow: which shou'd shew that *Snow has a secret Warmth*; otherwise it could hardly vivify. And the reason of the *Worm's* death, may be the sudden exhaling of that little flock of Spirit, as soon as it comes out of the Cold, which had shut it in *. For as *Butter-flies*, which were benumbed with Cold, quicken with Heat; so Spirits may exhale with Heat, which were preserved by Cold.

*A Creature
bred in the
Fire of a Fur-
nace.*

8. 'Tis affirmed both upon ancient and modern Observation, that in the Smelting-Furnaces for Copper and Brass, where *Chalcitis* † is often thrown in, to mend the working; there suddenly rises a *Fly*, which sometimes moves as if it took hold on the Walls of the Furnace; sometimes is seen moving in the Fire below; and dies as soon as it is out of the Furnace. This Instance deserves to be weigh'd ‡; as shewing that a violent Heat of Fire, as well as the gentle Heat of Animals will vivify, if it have Matter proportionable. The great AXIOM † of Vivification, is, (1.) that there must be Heat to dilate the Spirit of the Body; (2.) an active Spirit to be dilated; (3.) a viscous or tenacious Matter to hold in the Spirit; and (4.) this Matter must be put forth and figured. Now a Spirit dilated by so strong a Fire as that of a Furnace, presently congeals, as soon as the Furnace begins to cool. And possibly this Action is promoted by the *Chalcitis*, which has a Spirit that will shoot

*The Axiom of
Vivification.*

* To the curious in Experiments, upon Putrefaction and Vivification, the Subject of *Wine-Lees* deserves to be particularly recommended; as affording very extraordinary Phænomena. For Instance, when these Lees are pressed hard and dry, and suffer'd to heat, by standing open, or unclosed; they seem to turn entirely into Millions of *Animalcula*, that swarm and cling together as it were in one Lump; much thicker and closer than the Mites in rotten Cheese. Besides this, there are many more Particulars worthy of Attention, in the same Subject, with regard to the change of Colour, Odour, Taste, uncommon Stench, communicative Power, &c. For an Introduction to this particular Enquiry, see an uncommon manner of treating *Wine-Lees*, in the Essay lately published upon the business of Distillation, or the best Methods of producing, rectifying, and compounding inflammable Spirits, &c.

† Has the Fact, as to the Existence of a *Worm in Snow*, been verified?

‡ What is strictly and properly meant by *Chalcitis*, seems but little understood. 'Tis a Mineral, sui generis, and found in the Copper Mines of Germany, Sweden, &c. See *Agricola*, and the later Metallurgical Writers.

§ Let the Fact be first rigorously enquired into, as it highly deserves; for the Consequences are of great importance, if the Fact be true.

¶ Observe here an Instance of the AXIOMS, design'd for the sixth Part of the INSTAURATION; after they had been verified to the utmost: but all the Author could possibly do, for want of farther Experiments, and capital Instances in the Business of Induction, was only to make some first Attempts, to shew the way of forming these IMPORTANT AXIOMS.

shoot and germinate, as we see in chemical Trials. In short, most Things putrefied bring forth Insects of different kinds ^b.

9. *Insects* have been observed, but not with Diligence, to feed little : for *Grafs-hoppers* eat up the green of whole Countries ; *Silk-worms* devour Leaves fast ; and *Ants* make great Provision. 'Tis true, Creatures that sleep, and rest much, eat little ; as *Dormice*, *Bats*, &c. which are without Blood ^c : perhaps because the Juice of their Bodies is almost one and the same ^d. Some of them, indeed, have a *Diaphragm*, and an *Intestine* : and they have all Skins ; which in most of the *Insects* are often cast.

Observations upon the feeding of Insects.

10. They are not generally long liv'd ; yet *Bees* have been known to live seven Years : and *Snakes* are thought to live many Years ; perhaps from casting their Skins. *Eels* will live and grow a very long time : and those Creatures that change from *Worms* to *Flies* in the Summer, and from *Flies* to *Worms* in the Winter, have been kept in Boxes four Years. Yet there are certain *Flies* call'd *Ephemerae*, that live but a day. The CAUSE may be their want of Spirits ; or, perhaps, the absence of the Sun : for if they were hous'd, or kept close, they might live longer. Many Insects, being brought to the Sun, or Fire, easily revive, tho they seem'd dead ; and this by reason of the diffusion of the vital Spirit, and the easy dilatation of it by a little Heat. Some Insects stir a good while after their Heads are off, or after being cut in pieces ; perhaps because their vital Spirits are more diffus'd thro' all the Parts, and less confin'd to Organs, than in perfect Creatures ^e.

Their Time of Living.

Their stirring after Death.

11. *Insects* have voluntary Motion, and therefore Imagination ^f. As to what the Ancients have said of their Motion being indeterminate, and their Imagination indefinite ; this was negligently observed for *Ants* go strait forwards to their *Hills* ; and *Bees* know the way from a flowry Heath, two or three Miles off, to their own *Hives*. Perhaps, indeed, *Gnats* and *Flies* have their Imagination more mutable and giddy ; as small Birds likewise have. Some of the Ancients say, these Creatures have only the sense of Feeling : which is manifestly false ; for if they go strait to a place, they must needs have Sight. Besides, they delight more in one Flower, or Herb, than in another ; and therefore have Taste. And *Bees* are call'd with the sound of *Brafs* ; and therefore have Hearing : which shews likewise, that

Whether Insects think.

^b To pursue the Enquiry, (1.) all the kinds of Putrefaction shou'd be enumerated, and class'd, with regard to the different Creatures they appear to produce. (2.) Accurate Experiments should be made, to determine how far the Operation itself, and how far the Matter, or Seat of the Operation, contributes to the Production. (3.) Whether any Rudiments of *Insects*, *Eggs*, or *Animalcula*, are naturally contained within such Putrefactive Substances ; and are only extricated, excluded, or vivified in, or by the Operation ? And (4.) Lastly, Whether there be any such thing as *spontaneous Generation* ? with a strict Examination of all the capital Instances that appear to shew it. The strict inductive Method of prosecuting all such Enquiries is fully laid down in the *Novum Organum*, Part II.

^c Are *Dormice*, *Bats*, *Swallows*, &c. which sleep all the Winter, Creatures without Blood ? I suppose the Author means Blood with regard to redness of Colour : but is even this strictly true ?

^d See the Article SLEEP.

^e See the Observations upon *Tortoises*, *Vipers*, and other Creatures of this kind, in Mr. Boyle's *Philosophical Transactions*, &c. See also the Article LIFE.

^f This compar'd with the Doctrine of Mr. Locke, in his Essay on Human Understanding, concerning the Possibility of Matter's Thinking, may possibly solve his Difficulty.

tho their Spirit be diffused, yet the Seat of their Senses is in the Head.^a See the *Articles* ANIMALS, CATERPILLARS, GENERATION, LIFE, and PUTREFACTION.

L.

LASSITUDE.

The Cause and Remedy of Lassitude.

Lassitude is remedied by *batning*, or anointing with Oil and warm Water: for all Lassitude is a kind of Contusion of the Partsⁱ; but bathing and anointing, relax and supple. And a mixture of Oil and Water, is better for this purpose than either Oil or Water alone; because Water insinuates better into the Pores, and Oil, after entry, softens better^k. 'Tis found also, that the taking of Tobacco relieves in *Lassitude*. The Reason whereof may be, that by clearing or comforting of the Spirits, it opens the Parts compressed, or bruised; but chiefly, because it refreshes the Spirits by its opiate Virtue; and so discharges weariness, as Sleep does.

Why going up Hill tires the Knees.

2. In going up Hill, the *Knees* will be most weary; in going down Hill, the *Thighs*: for in lifting the Feet, when one goes up the Hill, the weight of the Body bears most upon the *Knees*; and in going down, upon the *Thighs*^l.

LEAPING.

The Use of Weights, and swinging the Arms in LEAPING.

A Man leaps better with Weights in his Hands, than without: because the Weight, if proportionable, strengthens the Sinews by contracting them^m. But otherwise, where no Contraction is necessary, Weight hinders; whence in *Horse-races*, Men are curious to examine, whether one Horse carries ever so little Weight more than another. In Leaping with Weights, the Arms are first thrown backwards, then forwards, with so much the greater Force; for the Hands are swung backward before the Leaper rises: and in throwing a Stone, the Arm is first cast backward, in order to make the greater swing. *Quære*, whether the contrary Motion of the Spirits, immediately before the Motion intended, does not cause the Spirits, as it were to break

^a And this, perhaps, may be the Case in all Animals; but the Thing should be verified by Experiment, and Crucial Instances.

ⁱ It may deserve to be enquired, how the Cold Bath, as well as the Warm, should presently take off weariness.

^k It is a remarkable Experiment, which shews that Water will enter where Air cannot; as particularly thro' the Pores of a Bladder, or perhaps any other Body, that is glutinous, mucilaginous, or sily.

^l And hence, perhaps, the Reason why some People can go up Hill better in proportion than down; viz. according to the difference betwixt the Strength or Ability of their *Hams* and *Knees*. And this may likewise be the Case with Horses: some whereof will run excellently upon a flat Course, but fail upon an uneven one.

^m I suppose the Author means by increasing their Elasticity; as when a musical Instrument is stretched, it will recoil with greater Force.

break out with more Force ⁿ? as the Breath drawn and kept in, comes out more forcibly °.

L I F E.

1. Some Creatures move a good while after their Heads are off, as *Birds*; *Of Motion after the instant of Death, with a View to its CAUSE.* some a very little time, as *Men* and all *Beasts*; some move tho cut into several pieces; as *Snakes, Eels, Worms, Flies*, &c. First therefore, the *immediate CAUSE of Death, is the Resolution, or Extinction of the Spirits*: the Destruction or Corruption of the Organs, being only the mediate Cause. But some Organs are so absolutely necessary, that the extinction of the Spirits speedily follows upon their Destruction; tho there is some small Interval. 'Tis credibly reported, that a sacrificed Beast has lived after the Heart was taken out; and that the Head of a Pig being open'd, and the Brain put into the Palm of a Man's Hand, without breaking any part of it, or separating it from the spinal Marrow, the Pig remain'd in all appearance dead and motionless; yet when after a small time the Brain was replaced, and the Scull closed, the Pig soon after walked. And an *Eye* upon the Act of Revenge has started out, so as to hang a considerable distance by the optic Nerve; and during that time the Eye was without any power of Sight: yet after, being replaced, the Sight was recovered °.

2. Now the *Spirits are chiefly lodged in the Head, and Cells of the Brain*, *The vital Spirits of some Creatures seated chiefly in the Head.* which in Men and Beasts is large; and therefore when the Head is off, the Body moves little or nothing. But *Birds* have small Heads; whence the Spirits are a little more dispersed in the Nerves, whereby Motion remains in them a little longer °; insomuch that a Roman *Emperor*, to shew the certainty of his Hand, is related to have shot a forked Arrow at an *Ostrich*, as she ran swiftly along the Stage, and struck off her Head; yet she continued running a little way with her Head off. As for *Worms, Flies, and Eels*, the Spirits

ⁿ For Instance, in the Case of a Racer, who has carried Weights in his Pocket, a little before he is to run: for such Practices seem to have considerable Effects, more than can well be attributed to the bare loading of the Body; and then laying the Load aside. And *Query*, what length of Time these Weights are best carried before the Race; whether some Hours, or Days?

^o The *Doctrine of Exercises* seems reducible to easy *mechanical Rules*. Thus, the Weights held in the Hands in Leaping, stretch the Arms, and cause them to move, or swing like Pendulums, or in a kind of Semicircle, whereby the Body is carried somewhat higher, and farther, before it comes to the Ground. Let *Borelli* be consulted upon the Subject.

^p There are many *Instances* of this kind related by Authors, and handed down by Tradition: certainly they should not be rashly rejected, nor discountenanced by Ridicule; but strictly enquired into, by those who desire to discover the Works of Nature, and improve Philosophy. For who knows the Lengths whereto Nature may go in all Cases? *Credulity*, however, is to be as strictly guarded against; in making a proper Collection of these *capital Instances*: which if extant, in tolerable Perfection, many *great Effects*, with regard to *Life and Death*, might possibly be wrought from the *Axioms* they would indicate. See the Author's *History of Life and Death*.

^q The Reader, perhaps, cannot too closely attend to these Beginnings, or first Attempts of the Author, for interpreting Nature. Such Attempts are numerous throughout all the Work: and the way of improving them is sufficiently laid open in the *Novum Organum*.

Spirits are diffused almost all over them : whence these Creatures move, tho cut into several pieces^r. See the *Articles* INSECTS and MOTION.

*The means of
prolonging Life.*

3. It conduces to long Life, and the more placid Motion of the Spirits, which thence prey less upon the Juices of the Body ; (1.) that Mens Actions be free and voluntary, so as nothing may be done against the Grain ; (2.) that their Actions be full of Regulation, and Commands within themselves : for then the Victory and performing of the Command, gives a good Disposition to the Spirits ; especially if there be a Progression from degree to degree : for then the Sense of Victory is the greater^t. An Example of the *former*, we have in a *Country Life* ; and of the *latter* in Monks, Philosophers, and such as continually enjoin themselves Tasks^u.

L I G H T.

*The Result of
many Experi-
ments upon the
shining of rot-
ten Wood.*

1. I have with some Diligence pursued the *Experiment of Wood shining in the dark* : the rather, because of all Things that give Light here below, it is the most durable ; yet has the least apparent Motion. *Fire and Flame* are in continual Expende ; *Sugar* shines only while it is scraped ; and *Salt-water* while it is dashing : *Glow-worms* shine only while they are alive, or a little after ; only the Scales of *putrefied Fishes* seem to be of the same Nature with *shining Wood* : and indeed all *Putrefaction* is attended with an internal Motion ; as well as Fire or Light^v.

2. The result of my Enquiry is this : (1.) That the shining is in some Pieces more bright, in others more dim ; but the most bright of all does not equal the Light of the *Glow-worm*. (2.) The kinds of *Wood* that have been found to shine, are chiefly *Sallow, Willow, Ash, and Hazle* ; tho perhaps it may also hold of others. (3.) Both the Roots and Bodies of the Tree shine ; but the Roots the better. (4.) The Colour of the shining part, by Day-light, is in some pieces White ; in some, inclining to Red. (5.) The part that shines, is generally a little soft, and moist ; but some was found to be firm and hard ; so that it might be fashion'd into a Cross, or Beads^w, &c. But we must not expect an *Image*, or the like, in any thing Luminous ; for even a Face in Iron, red hot, will not be seen ; the Light confounding the small Differences of Light and Dark, which shew the Figure^x. (6.) The shining part being pared off, till we came to that which did not shine ; within two Days the part contiguous also began to shine ; being exposed to the Dew : so that it should seem the Putrefaction spreads. (7.) Other dead Wood of the like kind, being exposed in the Air, shone not at the first ; but after a Night's lying, it begun to shine. (8.) Other Wood

^r Mr. Boyle, and some few others, have prosecuted this Enquiry : but it still seems to require more Hands.

^t Hence *Hope* is, perhaps justly, accounted a *wholesome Passion*.

^u See this Subject prosecuted in the Author's *History of Life and Death*.

^v This is a capital Observation.

^w This might be a gainful Intimation in a *Catholick Country*.

^x Here lies the Foundation of Painting, or what they call *Chiaro Obscuro*, or *Light and Shadow*.

Wood, that shone at first, being laid dry in the House, lost its shining Faculty within five or six Days; and being exposed again, recover'd it. (9.) Some shining Woods being laid in a dry Room, lost their shining Property within a Week; but being laid in a Cellar, or dark Room, retain'd it. (10.) The boring of Holes in this kind of Wood, then laying it abroad, seems conducive to make it shine: *as all Solution of Continuity promotes Putrefaction* *. (11.) No Wood has been yet found to shine, that was cut down alive; but such only, as was rotted both in the Stock, and Root, as it grew. (12.) Part of the Wood that shone, being steeped in Oil, retain'd the shining Virtue for a Fortnight. (13.) The like Success, but in a much greater degree, attended some that was steeped in Water. (14.) How long the shining will continue, if the Wood be exposed every Night, and taken in and sprinkled with Water in the Day, is not yet tried. (15.) Trial was made of exposing it in frosty Weather; which did not hurt it. (16.) The shining part being cut off from a great piece of a Root, till what was left shone no more; yet after two Nights, tho kept in a dry Room, it shone again †. See the *Article VISION*.

LIQUIFACTION.

1. Liquifaction is caused by the *Detention of the Spirits which play within the Body, and open it* ‡. Therefore such Bodies as are, (1.) more turgid with Spirit; or, (2.) have their Spirits more closely imprison'd; or, (3.) hold them more at ease, are *liquifiable*: for these three Dispositions of Bodies keep in the Spirits. An Example of the two first Properties we have in Metals; and of the last, in Sulphur, Pitch, Wax, &c.

*The Cause of
Liquifaction in
Bodies.*

2. The *Indisposition to liquify, proceeds from the easy Emission of the Spirits, whereby the grosser Parts contract*; and therefore, Bodies jejune in Spirits; or that willingly part with their Spirits, are not liquifiable; as Wood, Clay, Free-Stone, &c. Yet many of those Bodies that will not melt at all, or else with difficulty, however grow soft; as Iron at the Forge: and a Stick bathed in hot Ashes, thereby becomes more flexible §.

*The Cause why
Bodies are not
liquifiable.*

3. Some Bodies liquify or dissolve by Fire; as Metals, Wax, &c. and others dissolve in Water; as Salt, Sugar ¶, &c. The CAUSE of the former, is the *Dilatation of the Spirits by Heat*: and of the latter, the *opening of the tangible Parts*, which have an Appetite to receive Moisture. Again, some Bodies dissolve both in Fire and Water, as Gums **, &c. And these are

*Some Bodies
liquifiable by
Fire, others by
Water.*

V O L. III.

R

such,

* This is a noble Intimation for the *History of Putrefaction*.

† These Experiments perhaps have rather been verified and repeated, than greatly improved and extended by the later Writers. See Mr. Boyle, Dr. Power, Dr. Hook, &c.

‡ This Doctrine of Spirits, will appear so strange to many, that it can scarce be sufficiently guarded; unless the Reader has himself been conversant with close Observations and Experiments.

§ On this Experiment stands that noble Discovery of bending large Timbers, for the Building of Ships, now commonly practised in all the Yards.

¶ Salt and Sugar also dissolve by Fire, and run thin.

** Some Gums dissolve in Water, and others not; of the former kind are Gum Arabic, Gum Tragacanth, &c. of the latter, Galbanum, Storax, &c.

such, as have both Plenty of Spirit; and their tangible Parts indigent of Moisture: the former promotes the Dilatation of the Spirits by the Fire; and the latter stimulates the Parts to receive the Liquor^d.

M.

MAGNETISM.

Leading Experiments upon the Magnet.

1. **T**HE *Loadstone* attracts the Powder of prepared Steel; such as they use in Medicine^e; and even calcined Steel, reduced to a fine black Powder: and this as strongly, as it does the crude Filings of Iron: but for the artificial *Crocus Martis*, the *Loadstone* attracts it faintly.

2. If the *Iron* be dissolved in *Aqua fortis*, and some drops of the Solution be laid upon a flat Glafs; the *Loadstone* neither attracts the Solution itself, nor the Iron out of it.

3. The *Loadstone* attracts its own Filings, as if they were *Filings of Iron*; and very little pieces of a *Loadstone* attract one another, so as to become pendulous, and apparently united like a Hair or Needle.

4. If a *Loadstone* be placed at such a distance from *Iron*, as not to attract it, and an *Iron Cap* be placed between them; it will now attract it; tho the distance be the same: the Virtue of the *Magnet* being better diffused thro' *Iron*, than thro' the medium of the Air alone.

5. If a *Loadstone* be plunged in *Aqua fortis*, and there suffered to remain for several Hours, it loses no part of its Virtue.

6. The *Loadstone* does not increase its Virtue, by being rubbed upon Cloth, as Amber does; or against another *Loadstone*: nor by being heated at the Fire.

7. One *Loadstone* has a much more attractive Virtue than another; and in proportion thereto, transmits its Virtue to *Iron* upon the touch: and this Virtue is not only a Virtue of *Verticity*, but also of *simple Attraction*; for if a piece of *Iron* be touch'd with a strongly attractive *Loadstone*; and another piece in like manner by a weaker; the *Iron* touch'd by the stronger *Loadstone*, will attract a greater weight of *Iron*, than the piece will that was touch'd with the weaker.

8. The *Loadstone* attracts *Iron* at an equal distance thro' *Air*, *Water*, *Wine* and *Oil*.

9. *Loadstone*,

^d The due Prosecution of this Enquiry, has a great regard to the improvement of *Metallurgy*, *Pharmacy*, and *Chemistry*. The generality of Philosophers seem to have overlook'd it. But Dr. Stahl has many noble *Observations* and *Experiments*, that may add much Light to the Affair. See also Mr. Boyle upon *Fluidity* and *Firmness*, &c. It were proper in this Enquiry, to class Bodies, according as they are disposed for *Fusion*, or *Liquifaction*, by the Fire; as the Author has here begun: and by means of certain Tables, to shew at one View, the Bodies with their several *Menstruums*. It is not easy to imagine of how great Service this Procedure wou'd be in *Chemistry*, and *practical Philosophy*; and to what considerable Discoveries it might lead. Perhaps the want of a proper Solvent for the Stone in the Bladder, is owing to a neglect herein.

^e Does the *Loadstone* attract *Iron* prepared with *Sulphur*?

9. *Loadstone*, either whole or powdered, put into *Aqua fortis*, does not dissolve, in the least, as Iron does; tho *Loadstone* may otherwise seem a Body of the same Substance with Iron.

10. *Powder'd Loadstone* neither attracts *touched* nor *untouched* Iron; yet the Powder is attracted by *touched* Iron, but not by *untouched*: so that *powder'd Loadstone* seems, in some measure, to retain the passive, and lose the active Virtue of the Stone.

11. If a *Needle*, when laid upon a Plane, prove somewhat too heavy for the *Loadstone* to attract; yet the *same Needle* being laid upon the foot of an inverted drinking Glass, so as to hang over the Edges, on both Sides; the *same Loadstone* will then attract it. Which Observation deserves the rather to be related; because something of this kind might possibly give occasion to the frivolous Story, that the *Diamond* obstructed the Virtue of the *Magnet*. For if a *Needle* be laid upon a small *Table-Diamond*, and the *Loadstone* be held at a greater distance than its attractive Virtue reaches; yet the *Needle* will tremble: whilst this trembling is not a suppression of Motion, but Motion itself.

12. The *Loadstone* attracts *touch'd Iron* more strongly than *untouch'd*, in the proportion of three to one; or at three times the distance.

13. No *Iron*, or metallic Matter, is extracted from the *Loadstone* by Fire; nor is there any visible separation made^f.

14. The *Loadstone* dissolves not in *Aqua regia*, any more than in *Aqua fortis*.

15. If a *Loadstone* be detain'd in an ignited *Crucible*, but so as not to flame; it loses much of its Weight, and more of its Virtue: so as scarce afterwards to attract *Iron*.

16. *Loadstone* melts with difficulty, but somewhat changes its Figure, and grows red in the Fire, like *Iron*.

17. If a *Loadstone* be burnt whole in the Fire, it retains its passive Virtue, so as to follow another *Loadstone*; but almost loses its active Virtue of attracting *Iron*.

18. A *Loadstone* burnt in a *Crucible*, emits a Fume, tho it be scarce visible; which somewhat blanches a Plate of *Copper*, laid over it, as Metals usually do.

19. The *Loadstone* in burning, passes thro' the *Crucible*; as appears by the shining of the *Crucible* when broke, both on the inside and the out.

20. 'Tis universally agreed, that if a *Loadstone* be so far burnt, as to yield a certain dull and sulphureous Flame, it totally loses its Virtue; so as never to recover it again, tho cool'd in the Position of *North* and *South*: which is a Thing that gives a magnetic Virtue to *Bricks*; and restores it in *Loadstones* that have not been burnt to the utmost.

21. An Experiment was made of the *Loadstone*, and a touched *Needle*, upon the top of *St. Paul's Church* at *London*; which is one of the highest in

R 2

Europe,

^f Has the proper *Flux* been used for this purpose?

Europe, but the attractive Virtue was not found in the least diminish'd, or any way alter'd by that Distance from the Ground ^z.

M A N N A.

The Origin of Manna.

The *Manna* of *Calabria* is collected in greatest Plenty, and accounted the best: they gather it from the Leaf of the *Mulberry-tree*; but not such as grow in the Valleys. And *Manna* falls upon the Leaves by Night; as other Dews do ^a. It shou'd seem, that before these Dews can come upon the Trees in the Valleys; they dissipate, and do not hold out. The *Mulberry-leaf* also may have some coagulating Virtue, which inspissates the Dew; for 'tis not found upon other Trees: and we may see by the Silk-worm, which feeds upon that Leaf, what a curious smooth Juice it has. The Leaves also, especially those of the black *Mulberry*, are somewhat bristly; which may help to preserve the Dew. It were proper to observe, with greater Diligence, the Dews that fall upon *Trees*, or *Herbs* growing upon Mountains; for perhaps many Dews fall, that spend themselves before they come to the Valleys ⁱ. And I suppose, he who would gather the best *May-Dew* for Medicine, should gather it from the *Hills* ^k.

MATURATION.

The means of Ripening Liquors.

1. To accelerate *Maturation*, is a Capital Work in *Nature*. The *Maturation of Drinks* is wrought by collecting the Spirits together, where- by

^z These Experiments are not like those we commonly meet with in Writers upon this Subject; but, in the peculiar way of the Author, directly levelled at finding the CAUSES of *Magnetism*. Millions of random Experiments may be made with the *Loadstone*; which, however curious or surprizing, shall make but little to the Merits of the Enquiry: they are leading Experiments, crucial Instances, larger Observations, Canons, and general Axioms, that are wanting on this occasion. And unless the Experimentor has a View to these, he may waste much Time in *Magnetics* to very little purpose. But for the particular Method of conducting this Enquiry, 'tis proper, as upon all the like occasions, to refer to the second Part of the *Novum Organum*. See also Mr. Boyle, upon the Subject of *Magnetism*; Mr. Whiston's *Dipping-Needle*; the *Philosophical Transactions*, &c.

^a Possibly this may be a vulgar Error; or an Instance of *hasty Induction*. It should rather seem, so far as the later Observations and Experiments reach, that *Manna* is an exudation in the Leaves of certain Trees; and no other than a *saccharine Juice*; wherewith many Trees abound: as particularly the *Birch*, the *Sycamore*, the *Maple*, &c. And cou'd not *Manna* be made from the *Tears* or *Tappings* of the Trees, whereon it is found? See the Article SUGAR.

ⁱ These Observations upon Dews, have not been closely prosecuted; and, perhaps, there is some considerable Mystery in them.

^k The Foundation for the Rule seems to be this, that the *Atmosphere* is more impregnated with gross terrestrial Effluvia, Smoke, &c. near the Surface of the Earth, than higher up: and accordingly the purest Water appears to be collected in high Places; at a considerable distance from large Towns. But how this may hold of Dew, is another Question. To render Dew medicinal, perhaps it should participate of the Plants it hangs on; where it may drink in part of their finer Particles. But Experiment alone can determine this. There is much Curiosity, and some Utility, in tracing the History of *Manna*; thro' (1.) its first Preparation; (2.) Collection; (3.) Adulteration; (4.) proper Refinement, and exact Imitation; by means of the Materials of every Country. The History of *Sugar* might give Light in this Affair.

by they more perfectly digest the grosser Parts: and this is effected partly by the same means as *Clarification*¹. But *extreme Clarification* spreads the Spirits so smooth, that they become dull; and render the Drink dead: which ought to have a little flowering. Whence all clear, *Amber Drink* is flat^m. The degrees of Maturation in Drinks, are observable in *Must*, *Wine*, and *Vinegar*: In *Must*, the Spirits are not well collected togetherⁿ; *Wine* has them well united; so that they make the Parts somewhat more oily^o: whilst *Vinegar* holds them collected more jejunely, and, in smaller quantity; the largest and finest Spirit thereof being exhaled^p: for *Vinegar* is made by setting a Vessel of *Wine* in the hot Sun; and therefore *Vinegar* will not burn; because many of the finer Parts are exhaled^q.

2. The refreshing and quickening of palled or dead Drink, proceeds from enforcing the Motion of the Spirit: Thus we find, open Weather relaxes the Spirit, and makes it more lively in its Motion. We see also the *bottling* of *Beer* or *Ale*, while new, and full of Spirit, makes the Drink more quick and windy^r. A Pan of Coals, likewise, does good in the Cellar, and makes the Drink work again^s: nay, 'tis affirmed, that a brewing of new *Beer*, set by old *Beer*, makes it ferment again^t. It were also proper to *ferment the Spirits by Mixtures*, that may excite and quicken them; as by putting into the Bottles, *Nitre*, *Chalk*, *Lime*^u, &c. We see *Cream* is matured, and

The ways of recovering flat Liquors.

¹ See the Article CLARIFICATION.

^m Could not this Effect be easily prevented? Or could not *Malt Liquors* be racked from their Lees, and fined, and treated as *Wines*? Some *Experiments* have been made with Success in this way. And perhaps it is a vulgar Error to imagine, that *Malt Liquors* must needs lye upon their Lees, to preserve their briskness. A skilful Operator may do something considerable in this matter.

ⁿ In reality, perhaps, they are not formed: the vinous, or inflammable Spirits certainly are not exalted; so as to preside, in the Form of inflammable Spirits.

^o In *Wine*, the Operation of *Fermentation*, which perhaps consists in thousands of *Occursions* and *Attritions* of the small Particles among one another, forms part of the oily Matter, and Acid of the Subject, into *vinous*, or *inflammable Spirit*.

^p There is a great Secret in *Acetification*; known perhaps but to very few: those who have it, may, with Dr. Stahl, convert *perfectly rectified Spirit of Wine* into *Vinegar*; and produce strong and noble *Vinegar*, from *exceedingly cheap Commodities*; in the space of a very few days; even in the *Winter*. See the Article VINEGAR.

^q Some of the finer Parts of the *Wine* will doubtless be evaporated: but the Question is, whether the *inflammable Spirits* evaporate in the Operation; or are not really incorporated, lost in their former Nature, and converted into a very different Thing? For cannot the *best Wine*, contained in a *close Bottle* be converted, *barely by Heat*, into *excellent Vinegar*?

^r A careful distinction should be observed, in this whole Enquiry, betwixt *inflammable Spirit*; and what may for clearness sake, be called the *wild, crude, or gassy Spirit*; which chiefly shews it self whilst *Liquors* are new; or before they have finished their Course of *vinous Fermentation*.

^s The *Germans* make excellent use of this Contrivance, in their *Wine Vaults*; and thus become a kind of *Creators* in the Affair of *Wines*.

^t The Truth of this *Faith* can hardly be question'd by those who have been conversant in *Wine Vaults*. And considerable Secrets lie in the proper management of this *Natural Power*.

^u The best Additions of this kind, are, perhaps, the common ones; viz. a little *Sugar*, or two or three *Raisins*.

and made to rise more speedily, by the addition of cold Water; which seems to get down the *Whey* ^v.

And preserving them fresh.

3. It has been try'd, that burying well stopped Bottles of Drink, either a good depth in dry Earth, or at the bottom of a Well, within Water; but best of all by hanging them in a deep Well, somewhat above the Water, for a Fortnight, are excellent means of making Drink fresh and quick: for Cold does not exhale the Spirits at all, as Heat doth; but makes them vigorous, and active: whereby they perfectly incorporate the Parts of the Liquor ^w.

The means of ripening Fruits.

4. The *Maturation of Fruits*, is effected, (1.) by calling the Spirits of the Body outward; and so diffusing or spreading them more easily: and (2.) by digesting, in some degree, the grosser Parts: and this is procured, (1.) by Heat, (2.) Motion, (3.) Attraction; and (4.) a beginning Putrefaction, which is a kind of *Maturation* ^x.

Experiments of Maturation tried by enclosure in Apples.

5. Apples were laid in, (1.) Straw; (2.) in Hay; (3.) in Flower; (4.) in Chalk; (5.) in Lime. (6.) Others were cover'd over with Onions; (7.) others with Crabs; (8.) some were closed up in Wax; another shut in a Box, &c. and (9.) one was hung up in Smoak ^y. After a Month's time, the *Apple enclos'd in Wax*, was as green, and fresh, as at the first putting of it in; the Kernels continuing white. For all exclusion of open Air, which is ever predatory, maintains the Body in its first Freshness and Moisture ^z: but the inconvenience was, that it tasted a little of the Wax; which, I suppose, wou'd not happen in a Pomegranate, or some such thick-coated Fruit. The *Apple hung in Smoak*, grew, like an old mellow Apple, wrinkled, dry, soft, sweet; and yellow within: for such a degree of Heat, which neither melts nor scorches, mellowes without burning. The *Smoak* also sprinkles, as it were, the *Apple* with Soot; which promotes Maturation. So in drying of Pears and Plumbs by the Oven, and removing them often, as they begin to sweat; there is a like Operation: but this is perform'd with a far more intense degree of Heat. The *Apples buried in the Lime and Ashes*, were well matured; as appeared both by their Yellowness and Sweetness. For that degree of Heat, which is in *Lime* and *Ashes*, being a smothering Heat, is of all others the most proper for the purpose; as it neither liquifies nor dries: which is true *Maturation*. And the Taste of the Apples was good; so that the Experiment is fitted for Use ^a. The *Apples covered with Crabs and Onions*, were likewise

^v Heat has the same, or, perhaps, a greater Effect, in making the Cream rise and separate.

^w These are very useful Hints for a History of vinous Fermentation; with all its Accidents, Concomitants, and Attendants.

^x Here seems to be a good Foundation laid for the Enquiry.

^y There is a great Advantage attending the making of Experiments thus in Concert; or several of them together, where the Subject will admit of it: for by this means more Light is gained by Comparison; and the Tendency of the whole leads the sooner to AXIOMS.

^z This is a kind of AXIOM. See the History of Life and Death.

^a If proper Sets of these Experiments were made, they might afford excellent Rules for Practice, of great Use in ordinary Life. And this should always be remember'd, that an Experiment judiciously made and consider'd, never fails of affording either Light, or Advantage, and not unfrequently both.

likewise well matured : not by Heat ; but because the *Crabs* and *Onions* draw out the Spirits of the Apple ; and spread them equally throughout the Body : which cures Hardness. So we see one Apple ripens sooner against another ; and therefore, for making *Cyder*, they lay the Apples first in a Heap : and so one Cluster of Grapes that touches another as it grows, ripens faster. The *Apples in Hay* and *Straw*, ripened apparently, tho not so much as the other ; but those in the Straw ripened most. The *Cause* is, that the Hay and Straw have a very low degree of Heat, yet close and smothering ; which does not dry. The *Apple in the close Box* was likewise ripened ; for all Air kept close, has a degree of Warmth ; as we see in *Wooll*, *Fur*, *Plush*, &c. All the former being compared with another Apple of the same kind, that lay by itself, were found more sweet and yellow ; and consequently appeared more ripe.

6. The rolling of Apples, &c. softens and sweetens them presently ; which is owing to nothing but the even Distribution of the *Spirits* into the Parts : for it is the unequal Distribution of the Spirits, that makes the Hardness. But this hard rolling is a degree between *Concoction* and *simple Maturation* ; and therefore, if you roll them but gently, about twice a-day, and continue it for six or seven Days, they might, perhaps, ripen better ; and more like to the natural Maturation ^b.

Experiments of Maturation, by rolling and pressing.

7. Cut a Piece off the top of an Apple, and cover it ; to try whether Solution of Continuity will not hasten Maturation. We see that where a Wasp, Fly, or Worm, has bitten ; as in a Grape, or other Fruit ; the Fruit will sweeten soon ^c. Prick an Apple full of shallow Holes, and smear it a little with Sack, or Cinnamon-water, or Spirit of Wine, every Day, for ten Days ; to see if the virtual Heat of the Wine, or Strong-water, will not mature it. And in these Trials, keep one of the same Fruit untouched, to compare them with ^d. See the *Articles*, CLARIFICATION, and PERCOLATION.

By Solution of Continuity.

M E D I C I N E.

1. There are many Medicines which, of themselves, would do no good, and, perhaps hurt ; but being applied in a certain Order, one after another, effect great Cures ^e. I have tried a *Remedy for the Gout*, which has seldom failed to drive it away in twenty-four Hours ^f. It is, first, to apply a *Poultis* ;

Of the Order in which Remedies should be used.

^b This Experiment may well deserve to be tried.

^c Does the *Bite* occasion the Fruit to ripen faster ? Or, was it not riper before, than others of the same Tree ; and therefore chose by the Creature ? For *Snails*, *Ants*, *Wasps*, and *Insects*, seem to have acute Senses, or a particular Sagacity, in distinguishing the first beginning of Maturity in Fruits.

^d This Enquiry richly deserves to be prosecuted.

^e The following *Particulars* have regard to the *Filum Medicinale*, mentioned by the Author in the *De Augmentis Scientiarum*, Sect. X.

^f It may deserve a particular Enquiry, what Effects the wearing of a Lump of Brimstone next the Skin ; or the gentle rubbing of Flower of Brimstone upon the Part affected in the Gout, will have : for very considerable things have been related of both, by credible Persons.

A Poultis.

*Fomentation,
and*

*Plaster for the
Gout; to be
used succes-
sively.*

Poultis; then a *Fomentation*; and, lastly, a *Plaster*. The *Poultis* relaxes the Pores, and disposes the Humour to exhale. The *Fomentation* gently draws out the Humour by Vapour; because of the way made by the *Poultis*; and therefore only perspires the Humours, without drawing more to the Part: for it is a gentle *Fomentation*, and has, withal, a little Mixture of a Stupefactive. The *Plaster* is moderately astringent; which keeps back new Humours. The *Poultis* alone would make the Part more soft, weak, and apt to receive the Defluxion, and Impression of the Humour. The *Fomentation* alone, if it were too weak, would perspire but little, unless way were made by the *Poultis*; and if too strong, it would attract to the Part, as well as from it. The *Plaster* alone would pen up the Humour, already contained in the Part; and so exasperate it: and therefore they must all be used in *Succession*. The *Poultis* is to lie for two or three Hours: the *Fomentation* for a quarter of an Hour, or somewhat more; being used hot, and seven or eight times repeated: the *Plaster* is to continue on, till the Part be well confirmed. The Receipt of each take as follows.

The POULTIS.

2. Boil the Crumb of the finest Bread in Milk, to a Pulp; add at the end, a Dram and half of the Powder of red Roses; ten Grains of Saffron; an Ounce of Oil of Roses: and spread it upon a linen Cloth, to be applied lukewarm, and continued for three Hours.

The FOMENTATION.

3. Take of Sage Leaves, half a Handful; of the Root of Hemlock, sliced, six Drams; of Briony Root, half an Ounce; of the Leaves of red Roses, two Pugils; boil them in two Quarts of Water, wherein Steel has been quenched, till the Liquor come to a Quart. After straining, put in half a Handful of Bay-Salt. Let it be used with a scarlet Cloth, or scarlet Wooll, dipped in the hot Liquor; and so renewed seven times in a quarter of an Hour, or a little more.

The PLAISTER.

4. Take as much Emplastrum Diachalciteos as suffices to cover the Part; dissolve it, with Oil of Roses, to such a Consistence as will stick; and spread it upon a piece of Holland^e.

*Of Cure by
Custom.*

5. There is a secret, tho' unpractised, way of Cure; by accustoming oneself to what proves otherwise hurtful. Poisons have been made familiar to some Persons: Nurses in the Plague are seldom infected: Tortures, by custom have been made more easy: excessive Quantities of Meats, Wine, or strong Liquors, have, thro' custom, neither produced Surfeits, nor Drunkenness^h. And, generally, chronical Diseases; as Coughs, Phthificks, Palsies,

^e To judge from the Appearance of these three Receipts, they are safe; and are said, by others, as well as the Author, to have been serviceable.

^h The Constitution and Frame of the Body is so adapted, as to be capable of sustaining great Excesses, and Wants, without Prejudice: and it seems to remain unknown, to what Lengths either of these may, by Habit and Custom, be carried: insomuch, that surprizing Paradoxes might

Pallies, Lunacies, &c. are most dangerous at first: therefore a wise Physician will consider whether the Disease be *incurable*; or whether the *just Cure* of it be not *hazardous*; and if it be, let him have recourse to *Palliatives*; and alleviate the Symptoms, without busying himself too much with the *perfect Cure*: and this Course will often exceed beyond all Expectation. The Patient himself may likewise strive, by degrees, to overcome the Symptoms; and so, by time, turn suffering into *Nature* ¹.

6. Divers Diseases, especially chronical ones, are sometimes cured by *Surfeit and Excess*; as in Meat, and Drink, Fasting, Exercise, and the like. *Of Cure by Excess.* For *Diseases of Continuance*, get an *adventitious Strength from Custom*; besides, their material Cause from the Humours: so that the *breaking of the Custom*, leaves them only to their *first Cause*; which, if any thing weak, will fall off. Again; such *Excesses* stir and excite Nature, which thence riseth more forcibly against the Disease ².

7. There is a great *Consent* in the Motion of the several parts of the Body. *Of Cure by Motion of Consent.* Children, in Sport, will often try whether they can rub upon their Breast with one Hand, and pat upon their Forehead with the other; and sometimes they will rub with both Hands, or pat with both Hands. When the Spirits, that come to the Nostrils, expel a bad Scent, the Stomach is ready to expel by Vomit. In *Consumptions of the Lungs*, when Nature cannot expel by Cough, Men often fall into Fluxes of the Belly, and die. So *pestilential Diseases*, if they cannot be expelled by Sweat, cause a Looseness, that proves commonly mortal. Therefore, *Physicians should ingeniously contrive, how by Motions that are in their Power, to excite internal Motions not in their Power*; and this, by *Consent of Parts*: as by the stench of Feathers, or the like, they cure the rising of the Mother ³.

8. 'Tis a deep *Aphorism of Hippocrates*, that *Diseases contrary to the Complexion, Age, Sex, Season of the Year, &c. are more dangerous than those that are concurrent*. A Man would think otherwise; because when the Accident of Sickness, and the natural Disposition, second each other, the Disease should seem more powerful; and so it is, if we suppose like Quantity of Matter: but such Diseases shew a greater Collection of Matter; as being able to overcome those natural Inclinations to the contrary. And therefore, in Diseases of this kind, let the Physician apply himself more to *Purgation*, than to *Alteration*; because the *Offence is in the Quantity: and the Qualities will rectify themselves* ⁴.

V O L. III.

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might be derived from the *Enquiry*. There are some strange Relations to this Purpose, in the *Philosophical Transactions*; and *German Ephemerides*.

¹ There seems to be something very material in this Direction, worthy the regard of Physicians.

² Here are some useful Intimations given, for forming a Method of treating several Diseases, that vulgarly pass for *incurable*.

³ This is a noble Enquiry, but lies greatly neglected. It is, doubtless, a capital Secret in Medicine, to constrain Nature to co-operate with the Physician, by means of *Aversions*. And could not some considerable Cures be wrought, by the very *Aversion which some People have to the Sick*?

⁴ 'Tis great pity this Enquiry has not been far enough pursued, to afford some sure *Rules of Practice*.

Of Preparation before, and settling the Body after, Purging.

9. Physicians wisely prescribe *Preparatives* before *Purgation*; for Cathartics often prove very prejudicial, if the Body be not accommodated, both before and after them^a. The Mischief they do, for want of *Preparatives*, arises from the sticking of the Humours, and their not coming clean away; which causes great Perturbations in the Body, and ill Accidents during the Purging. It also checks the Operation itself; and therefore the Business of *Preparation* is double; viz. (1.) to render the Humours fluid and mature; and, (2.) to open the Passages: for both these help to make the Humours pass the freer. For the former purpose, *Syrups* are best; and for the latter, *Apozems*, or preparing *Broths*. *Glysters* also prevent the Medicine from lodging in the Guts, and Griping. But if the Body abound with Humours, or Fat; or if the Weather be open; these are *Preparatives* in themselves: because they make the Humours more fluid. But let a Physician beware of Purging after hard frosty Weather; and in a lean Body, without *Preparation*^o.

The Cause of Mischief after Purging.

10. As for the Mischief after Purging, it is caused by the lodging of some Humours in improper Places: for there are Humours, which lodged in certain places of the Body, are quiet, and harmless; but when lodged in others, do much Mischief^p. Therefore 'tis proper, after Purging, to use *Apozems*, and *Broths*; tho not so opening as those used before Purging. Also absterfitive *Glysters* are good to conclude with; to draw away the Relicks of the Humours, that may have descended to the lower Region of the Body^q.

Of stanching of Blood.

11. Bleeding is stopped several ways: first, by *Astringents*, and *Repercussives*; secondly, by drawing the Spirits and Blood, inwards; which is done by Cold; as Iron, or a Stone, laid to the Neck, stops bleeding at the Nose: it has also been tried, that putting the Testicles into Sharp Vinegar, has made a sudden Revulsion of the Spirits, and stanch'd Blood: thirdly, by the *Recess* or *Sympathy of the Blood*: so the bleeding Part, being thrust into the Body of a Capon, or Sheep, new cut up and bleeding, has stanch'd Blood^r: fourthly, by Custom and Time; so the Prince of Orange, in his first Hurt, by

^a I suppose, this is chiefly meant of the rougher Purgatives; such as *Scammony*, *Gamboge*, &c. but, for the milder; such as *Manna*, *Epsom Salt*, and, particularly, the *Mineral Purgings-Waters*; they seem to require much less preparation of the Body, and subsequent Caution. And, perhaps, it were best, in all Cases, to make choice of such Purgatives as are, in some degree, their own *Preparatives*; and innocent, both in their Operation and subsequent Effects: as the purging *Mineral Waters* seem remarkably to be.

^o Upon what Observations is this Caution grounded? Physicians are generally cautious of purging in frosty Weather, and chuse to defer it till such Weather breaks. Here is Matter of Enquiry: but the Misfortune is, that Practice is headstrong, and commonly runs before Enquiry.

^p This is an excellent Observation, and the Foundation of a very important Enquiry. See Mr. Boyle on *Specific Remedies*.

^q So common a thing as Purging is, and so many Hands as the Direction of it comes under; yet, what solid and settled Discoveries are made, with relation to it, capable of affording steady and just Rules of Practice? It has been before observed, and should ever be remembered, that Practice is the Touch-stone of Theories.

^r How far has this Fact been verified?

by the *Spanish Boy*, could find no Means to stanch the Blood by *Medicine*, or *Ligature*; but had the Orifice of the Wound stoppt by Mens Thumbs, succeeding one another, for the space of two Days; and, at last, the Blood retired by *Custom*. There is a *fifth* Way also in use; *viz.* to let Blood in a contrary Part, by way of *Revulsion* ^f.

12. 'Tis ever serviceable, *not to continue the same Medicine and Aliment too long*: for *Nature*, by continual Use of any thing, comes to a *Satiety and Dulness*, either of *Appetite or Working* ^g; and we see that a continued Use of hurtful things makes them lose their Force; whence, 'tis no wonder, if good things also lose their Force by custom. I account *Intermission* almost the same thing with *Change*; for what has been intermitted becomes, in a manner, new again ^h.

Of Change of Aliment and Medicines.

13. 'Tis found by Experience, that in the Use of *Diet-drinks* of *Guaia-cum*, *Sarsa*, and the like; the Patient is more uneasy at the beginning, than after continuing the Course: which has made some of the more delicate sort, give over in the middle; upon a Supposition, that if the Course was so irksome as at first, they could never hold out to the end. But the CAUSE is, that all such Courses dry up Humours, Rheums, and the like; which cannot be dried up till they are first attenuated: and when the Humour is attenuated, it becomes more fluid than before; and thus offends the Body much more, till it be consumed. And therefore Patients, under such Courses, must wait a due time; and not faint at the first ⁱ.

Of Diet-drink.

14. There is a great Variety of *Fossils*; but the *Veins of medicinal Earths* are few: the chief being *Terra Lemnia*, *Terra Sigillata*, and *Bolus Armena*; whereof the *Terra Lemnia* is the principal. Their Virtues are, to cure *Wounds*, stop *Bleeding*, *Fluxes*, *Rheums*, and the spreading of *Poison*, *Infection*, and *Putrefaction*: they have, of all *Simples*, the perfectest property of *Drying*, with little or no Mixture of any other Quality. But *Bolus Armeniac* is the coldest of them, and *Terra Lemnia* the hottest; whence the Island *Lemnos*, where 'tis dug, was, in the fabulous Ages, consecrated to *Vulcan* ^j.

The Virtues of Medicinal Earths.

S 2

15. The

^f The due Prosecution of this Enquiry into the several Ways of stopping Hemorrhages, might lead to the Discovery of better *Strychnicks*, than are hitherto commonly known.

^g Tho this *Aphorism* may possibly deserve to pass for an *Axiom*, yet it seems not yet drawn into *Rules for Practice*; nor, indeed, to be greatly regarded: tho, perhaps, capable of producing noble Effects in *Medicine*.

^h Here is another rational Foundation for attempting the Cures of some Diseases, vulgarly reputed incurable.

ⁱ This Doctrine seems deduced, with great Justness, from the Virtues of the Ingredients whereof *Diet-drinks* are usually made; and from careful Observation of their Success. Were it not proper, to apply the Author's *Method of interpreting Nature*, in many other Cases of Physick? Certainly a Set of *Rules* might, with care, be soon deduced in this manner, but who will undertake to verify them in Practice? for *Rules* unverified, are no *Rules* at all.

^j There seems to have been a considerable neglect in enquiring our the proper Virtues of *Earths*: some have attributed great Matters to them, and others allow them scarce any Virtues at all. The Question is not to be decided by *Dispute*, but *Experience*. And in this View let *Berber*, *Boyle*, and *Stahl* be consulted.

Of Medicines
that condense,
and relieve the
Spirits.

15. The *Turkish Drink*, called *Coffee*, is made of the *Coffee-berry*, having a strong Scent ; but not aromatical. This Liquor they take hot, and sit at it in their *Coffee-houses* ; and it comforts the Brain and Heart, and helps Digestion. Certainly, the *Coffee-berry*, the *Root* and *Leaf* of *Betel*, the *Leaf* of *Tobacco*, and the *Tear* of the *Poppy*, or *Opium*, which the *Turks* take largely, as supposing it to give Courage ; all condense the Spirits, and make them strong and alert. But, it seems, they are used after different Manners ; for *Coffee* and *Opium*, are swallowed down ; *Tobacco*, is smoked ; and *Betel*, is chewed in the Mouth, with a little *Lime*. Perhaps there are more of these, if found and well corrected : *Quære* ; of *Henbane-seed*, *Mandrake*, *Saffron*, the *Root* and *Flower* of *Folium Indicum*, *Ambergrease*, the *Affyrian Anomum*, *Kermes*, and of all such things as inebriate, and provoke Sleep. Note, that *Tobacco* is not taken in the *Root* or *Seed* ; which are always more powerful than the *Leaf* *.

Of the proper-
est Simples
for Medi-
cines.

16. Wise Physicians should diligently enquire, what *Simples* Nature yields of extreme subtle Parts, without Acrimony : for these undermine what is hard ; open what is stopped ; and gently expel what is offensive ; without too much Disturbance. Of this kind are *Elder-flowers* ; which are therefore, proper for the *Stone* : *Dwarf-pine* ; which is good for the *Jaundice* : *Piony* ; which is proper for Stoppages in the Head : *Fumitory* ; which is good for the *Spleen* : and many others. Several Creatures bred of Putrefaction, tho somewhat loathsome to take, are of this kind ; as *Earth-worms*, *Timber-sows*, *Snails*, &c. and, I conceive, that the *Troches* of *Vipers*, and the *Flesh* of *Snakes*, some way prepared and corrected, are of the same Nature. So the putrefied Parts of Beasts ; as *Castor* and *Musk* ; are to be placed amongst them. We see also, that the Putrefactions of Plants ; as *Agarick* and *Jews-ears* ; are of great Virtue : for Putrefaction is the subtlest of all Motions in the Parts of Bodies. And since we cannot take the Lives of Animals ; which, some fancy would thus make us immortal ; the next thing, for Subtily of Operation, is to chuse such putrefied Bodies as may be safely taken †.

A BROTH and FOMENTATION for the STONE.

A safe Remedy
for the Stone in
the Kidneys.

17. Take of *Eryngo Roots*, cleansed and sliced, one Dram ; boil them together with a Chicken ; at the end add, of *Elder-flowers* and *Marygold-flowers*

* It seems a great Neglect in *Medicine*, not to endeavour to discover and ascertain the Virtues of the *Simples*. For hence Conjectures, Rumours, Traditions, and Conceits, are every Day followed in prescribing them ; instead of *Experiments*, *Observations*, *Facts*, and *Certainties* : inasmuch, that there is room to ask, whether the Virtues of any one Simple, of all the thousands in being, are fairly manifested by competent Experience ? If not, 'tis surely high time to begin the Enquiry ; first by the *simplest Means*, and afterwards proceeding gradually to *Compositions* and *Combinations*. Let Trial, therefore, be made of *simple Infusions* ; of *simple Ingredients in Water* ; of *close Decoctions* of the same Plant. of *Robs*, *Extracts*, &c. each to be given separately, and repeated at due Distances ; without the Use of any other Medicine : for, till we know what Virtues the particular Parts of *Simples* have, respectively ; how can we judge of their Virtues in Composition ? Certainly this is an Enquiry, where nothing should be left to Imagination ; but the Conduct be strictly just, regular and experimental. See the *Novum Organum*, Part II.

† These are excellent Intimations ; but they seem to be strangely slighted.

flowers, one Pugil; of *Angelica-feed*, half a Dram; of *Raisins of the Sun* stoned, fifteen; of *Rosemary*, *Thyme*, and *Mace* together, a little. and, in six Ounces of this Broth, dissolve three Grains of *Cremor Tartar*.^a Every third or fourth Day, take a small Toast dipped in new drawn Oil of sweet Almonds, and sprinkled with a little loaf Sugar. You may make the Broth for two Days; and take one half every Day. If you find the Stone to stir, forbear the Toast for a Course or two. The Intention of this Broth is, not to bring away; but to undermine the Quarry of the Stones in the Kidneys².

TROCHES for the STOMACH.

18. Take of the best *Pearls*, very finely pulverized, one Dram; of *Stomachic Nitre*, one Scruple; of *Cremor Tartar*, two Scruples; of *Ginger* and *Gal-Troches* lingal together, one Ounce and a half; of *Calamus Aromaticus*, *Ellicampane-root* and *Nutmeg* together, one Scruple and a half; of *Ambergrease*, sixteen Grains; of *Musk*, ten Grains; and by Means of *Rose-water* thickened with *Gum Tragacanth* and the finest Sugar, make them into *Troches*³.

Another Medicine to strengthen the STOMACH.

19. Take *Lignum Aloes* in gross Shavings; steep them in *Sack* or *Alicant*, *A Medicine for the Stomach.* changed twice, half an Hour at a time; till the Bitterness be drawn out. Then dry the Shavings in the Shade, and beat them to a fine Powder; of which, with the Syrup of Citrons, make a small Pill. To be taken before Supper^b.

GRAINS of YOUTH.

20. Take of *Nitre*, four Grains; of *Ambergrease*, three Grains; of *A Medicine for Orrice-powder*, two Grains; of *white Poppy-feed*, a Grain; of *Saffron*, half a Grain; and with *Orange-flower-water*, and a little *Gum Tragacanth*: make them into four small Pills, or Grains. To be taken at four a-clock, or going to Bed. *procuring some degree of Rejuvenescency.*

PRESERVING OINTMENT.

21. Take of *Deer's-suet*, one Ounce; of *Myrrh*, six Grains; of *Saffron*, five Grains; of *Bay-salt*, twelve Grains; of *Canary Wine*, two Years old, a Spoonful and a half: spread it on the inside of the Shirt, let the Shirt dry, and then put it on^d. *The Author's Ointment for long Life.* WINE

² This Remedy appears to be very innocent; but how effectual, can only be learnt from Experience.

^a The Intention of these *Troches* seems to be warming, and strengthening to the Stomach; and promoting Digestion.

^b This Receipt appears to have some relation to the Author's *History of Life and Death*; where he particularly enumerates the practical Methods of prolonging Life; and, amongst other things, mentions the Introduction of a *ligneous Substance into the Blood*: tho the Medicine here set down, may otherwise have some more immediate Effect in strengthening the Stomach; as the Title expresses.

^c All the following Receipts have a more direct relation to the *History of Life and Death*; where they are, in a manner, indicated, or referred to, as means of prolonging Life. For the Author appears to have formed to himself a practical Method with such a View, upon the Doctrine, or Axioms, pointed out in that *History*.

^d The Use and Intention of this Ointment may sufficiently appear from the *History of Life and Death*,

*WINE for the SPIRITS.**His Invigorating Wine.*

22. Take Gold perfectly refined, three Ounces ; quench it six or seven times in good Claret Wine ; and, for two Draughts, add of *Nitre*, six Grains ; of *Saffron prepared*, three Grains ; of *Ambergrease*, four Grains : pass it thro' an Hippocras Bag, wherein there is a Dram of *Cinnamon* grossly beaten ; or, (to avoid muddying the Colour) of *Ginger*. Put two Spoonfuls of this to a Draught of fresh Claret Wine.

The Way of preparing the Saffron, is this,

Steep six Grains of Saffron in equal parts of Wine and Rosewater, and a fourth part of Vinegar ; then dry it in the Sun.

*WINE against MELANCHOLY, and for preserving the SENSES and REASON.**His Wine against Melancholy.*

23. Take the *Roots of Bugloss*, well scraped, cleansed, and separated from their inner Pith ; cut them into small Slices ; steep them in *Wine of Gold* prepared as above ; add of *Nitre*, three Grains. And drink it, mixed with fresh Wine, as the above described Wine for the Spirits. *Note*, The *Roots* should not steep above a quarter of an Hour ; and must be thrice changed^e.

*A RESTORATIVE DRINK.**His restorative Drink.*

24. Take of *Indian Maiz*, ground and sifted, half a Pound ; of *Eryngo Roots* and *Dates*, each three Ounces ; of *Ellicampane*, two Drams ; of *Mace*, three Drams : and brew them with Ten-shilling-beer, to the Quantity of four Gallons, by boiling them in two Quarts of Wort, to be afterward mix'd with the Beer. This is to be used familiarly at Meals.

*Against WASTE of the BODY, by HEAT.**His Preservative, against Waste by Heat.*

25. Strain *sweet Pomegranats*, lightly, into a Glass ; and add, a little *Citron-peel*, two or three *Cloves*, three Grains of *Ambergrease*, and a due Proportion of fine Sugar. This is to be drank, every Morning, whilst *Pomegranats* last^e.

METHUSALEM-WATER ; against all *Asperity* and *Parchedness* of the inward Parts ; all *Adustion* of the Blood ; and, generally, against the *Dryness* of Age.

His Water for prolonging Life.

26. (1.) Boil new *Crevises* well, in Claret Wine ; and rub the Shells very clean, especially on the inside ; then wash them, three or four times, in warm Claret, impregnated with the Tops of green *Rosemary*, still changing the Wine till all the Fish-taste be taken away : now dry the pure Shell thoroughly, and bring it to an exquisitely fine Powder. (2.) Steep *Pearl* in *Vinegar* for twelve Hours, then dry off the Vinegar ; and make this, also, into

^e Perhaps some would rather preserve the *Tincture* here, than the *prepared Saffron* : but this was not agreeable to the Design of the Author. Nor, indeed, can his Design be rightly judged of, without an Acquaintance with his *History of Life and Death*.

^f This is agreeable to the Doctrine delivered under the Article *INFUSION*.

^g See the *History of Life and Death*.

into an extreme fine Powder. (3.) Take of each Powder three Drams, a Scruple of *Ginger*, and half a Scruple of *Poppy-seed*; steep them seven Hours in *Spirit of Wine*, wherein six Grains of *Saffron* have been infused. Then, with a gentle Heat, evaporate all the Spirit, and dry the Powder in the Sun, without Fire. (4.) Add to it of *Nitre*, one Dram; of *Ambergrease*, a Scruple and a half; and keep this Powder for Use in a clean Glass. (5.) Slice four Ounces of fresh pared *Cucumbers*, into two Quarts of Milk, and draw off a Water by Distillation. (6.) Quench *Gold* four times in a Pint of *Claret Wine*. And, (7.) to the Wine and Milk-water, each three Ounces, add a Scruple of the Powder; and drink it in the Morning; stirring up the Powder before you drink: and walk upon it ^a.

M E T A L S.

1. The *Enquiry into Metals*, may well be accounted *capital*; for Metals are of great Service in Life. We will therefore here set down the *principal Heads*, that occur to us with regard to this Enquiry ⁱ.

Heads of Enquiry for the particular History of Metals.

ARTICLE I.

Of Separation.

2. Enquire into the Business of *Separation*: which is of three sorts; viz. (1.) *Smelting*, or *Refining*; (2.) *Extracting*; and, (3.) *Principiating*. *Smelting*, or *Refining*, is separating the pure *Metal* from its Ore, or Dross: *Extracting*, is the educing of one *Metal* out of another: and *Principiating*, is the resolving any *Metal* into its original or elementary Matter ^{*}.

Metalline Separation of three general kinds.

3. Let the *Enquiry of Smelting* be prosecuted thro' all the Metals, *Gold*, *Silver*, &c. and, by the way, enquire of the first *Stone*, *Ore*, *Spar*, *Marcasite*, and Beds of Metals, respectively; what Bodies they are, and their degrees of Richness. Thus the richest *Iron-stone* proves hardest to melt; but the case is otherwise in *Tin*, and *Lead* ¹.

viz. (1.) Smelting.

4. En-

^a To understand the Bottom of the Design, and full Intention of these several Remedies, requires a diligent Perusal of the Author's *History of Life and Death*: which will shew the Judgment of the Compositions; or the *inductive Foundation* upon which they stand. And unless a due regard be had to that History, the Author will, probably, appear to have here committed some gross Errors in *Pharmacy*. But his Views were very different from those in directing ordinary Medicines; and regarded the *restoration of Youth*, and *lengthening the common Period of Life*. And this Difference of Intention, requires a very different *Pharmacy* from the common.

¹ The following Heads are drawn up in the usual way of the Author, as a kind of *Outlines*, or *Skeleton*, of the particular History of METALS, that wants but to be filled up, to appear like his own *History of Life and Death*, *Winds*, &c. Certainly the Advantages of this Method are not duly understood by Mankind: tho' a few *Inventors*, or original *Enquirers* into the Works of *Nature and Art*, may seem to have followed it. But the thing, in itself, is of such Extent, and Utility, as, with a moderate Attention, to instruct Men of ordinary Capacities, to pursue *Enquires* with as much Success as Men of brighter Parts: for it indicates, not only the Particulars to be pursued, but also the *Method of pursuing*, till the Enquiry necessarily arrives at some considerable Discoveries. The *Novum Organum* has discussed this Matter; and there will be more said of it, in the *Introduction* to the *SCALA INTELLECTUS*.

^{*} These Particulars have been nobly prosecuted by *Becher* and *Stahl*.

¹ Consult *Agricola de Re Metallica*, and the later Metallurgists; particularly the *Germans*.

Of Separation
by Fire, or
Depart-wa-
ters, &c.

4. Enquire into the different Ways of *Separating* by *Fire*, *Depart-Waters*, or otherwise : and for the Manner of *Refining*, enquire, (1.) into the Methods of increasing the Heat ; (2.) accelerating the Operation ; and, (3.) saving of Charges. The Means are three ; and depend, (1.) upon the Blast of the Fire ; (2.) the Form of the *Furnace* ; for uniting, and reflecting Heat : and, (3.) the Use of Additions, or Matters which help the Ore, and open it sooner^m.

5. The Method of *quickening the Fire*, and multiplying the Heat, may be general ; and serve alike for all Metals : but the Additions shou'd be different ; and suitable to each Particular. It must not, however, be expected, that, by increasing the Addition in Proportion to the Ore, the Yield should answer ; for Quantity, in the *Passive*, adds more Resistance than it adds Force in the *Active*.

Of rendering
the baser Me-
tals finer.

6. 'Tis reported by the Ancients, that there was a kind of Steel, in some Places, which would polish almost as white and bright as Silver ; and that there was, in *India*, a kind of *Brass*, which, when polished, could scarce be distinguished from Gold. This was in the *natural Ore* ; but I question whether Men have sufficiently *refined the Metals* we account base ; as, whether *Iron*, *Copper*, and *Tin*, are refined to the height : for, perhaps, when they are brought to such a Fineness as serves for ordinary Use, Men do not try to refine them fartherⁿ.

(2.)
Extraction.

7. Under *Extraction*, enquire what *Metals* contain others : thus, Lead and Tin, contain *Silver* ; Lead and Silver, contain *Gold*, &c.

8. Let it also be enquired, what the Difference is in those *Metals* that contain more or less of others : thus, the Lead that contains most *Silver*, is accounted more brittle, and poor, than that which contains less.

(3.)
Principiation.

9. As for *Principiation*, whether there be really such a thing or no ; or only a *Solution*, *Extraction* or *Conversion* by the Fire ; it should be carefully examined, what *simple Bodies* are to be found in the several Metals ; and in what Quantity. Thus, *Quicksilver* and *Brimstone* are found in some *Minerals* : and, particularly, *Antimony* abounds with *Brimstone* ; as appears upon dissolving it in *Aqua regia*, whereby the *Brimstone* is made to float a-top.

ARTICLE II.

Of the Changes to be wrought upon Metals.

The several
Ways of chang-
ing Metals.

10. Under this Head, enquire into the Ways of *Tinging*, *Rusting*, *Calcin-
ing*, *Subliming*, *Precipitating*, *Amalgamating*, *Vitrifying*, and *Dissolving* of Metals in *Menstruums* ; their *Shooting*, *Sprouting*, or *Growing* into Trees ; the
Methods

^m See Stahl's *Philosophical Principles of universal Chemistry* ; which have a direct Tendency to fill up the several Heads of History here set down.

ⁿ *Regulus of Antimony* may, by repeated Operations, be refined to a great degree of Purity ; so as to approach the Whiteness, tho not the Malleability of Silver. But there seems to be no Methods, in common Use, of Refining *Gold* and *Silver* beyond one certain degree ; or, that of Twenty-four *Carats*, as it is called. And the same is to be understood of *Copper*, *Tin*, and *Lead* : but whether some chemical Operators have not *secret Ways* of improving or meliorating all these *Metals*, might deserve to be enquired into.

Methods of Hardening and Softening them ; making them Tough, or Brittle ; Volatile, or Fixed ; and Converting, or Transmuting them into one another.

11. Under *Tinging*, enquire how Metals may be tinged quite thorough ; with *viz.* (1.) what Matters, and into what Colours ; as in the Tinging of *Silver, yellow ; By Tinging. Copper, white, red, blue, green ;* yet so as to keep its Lustre. And this Enquiry may receive some Light from the *Tinging of Glass, Marble, Flint, or other Stone ;* and striking a variety of Colours thro' them.

12. Under the *Rusting* of Metals, enquire, chiefly, by what Corrosives this is effected ; and into what Colours the Rust turns : thus, *Lead and Tin,* corroded with *Vinegar,* turn white ; *Iron,* yellow ; *Copper,* green, &c. And all *Metals* seem subject to Rust ; unless it be *Quicksilver* and *Gold* : tho *Quicksilver* is turned into Vermillion, by subliming it with Sulphur ; and the *Scripture* mentions the Rust of Gold °.

13. Under *Calcination*, enquire how each Metal is calcined ; into what kind of Body it turns ; and the most exquisite Way of Calcining it : thus, all Metals may be calcined by *corrosive Spirits,* or the Admixture of *Salt, Sulphur,* and *Mercury ;* and the imperfect Metals, by the bare Continuance of Fire alone : but *Gold* and *Silver* are best calcined by *Mercury.*

14. Under *Sublimation*, enquire the manner of Subliming ; what Metals undergo this Operation ; and what kind of Sublimate the Body makes : thus, Metals are sublimed by joining them with Mercury, or Salts ; as Silver with Mercury, Gold with Sal-Ammoniac, and Mercury with Vitriol.

15. Under *Precipitation*, enquire, (1.) what Addition precipitates what Metal ; (2.) in what Time ; and, (3.) into what Body. The principal Additions for this Purpose are, *Salt-Water* and *Oil of Tartar.*

16. Under *Amalgamation* enquire, (1.) what Metals endure it ; (2.) what are the Means of effecting it ; and, (3.) what manner of Body it makes.

17. Under *Vitrification* enquire, (1.) what Metals are subject to it ; (2.) what are the Means of effecting it ; (3.) into what Colour it turns ; (4.) in what Cases the whole Metal becomes *Glass ;* and, (5.) in what Cases it only hangs in the glassy Parts ; (6.) what Gravity the vitrified Part has, compared with the *Metal ;* and, (7.) whether all *Metals* may be reduced from a State of Vitrification, to *Metal* again. The imperfect Metals are, by a strong Fire, convertible into *Glass ; Iron,* into a green ; *Lead,* into a yellow ; *Copper,* into a blue ; and *Tin,* into a pale yellow Glass : but *Gold* and *Silver* have not been vitrified at the *Furnace* P, unless joined with *Antimony.* And all these glassy Bodies are reducible to a metalline form again, by melting them with a large Proportion of fresh Metal.

18. Under *Dissolution* enquire, (1.) the proper *Menstruum* for dissolving each Metal ; (2.) what *Menstruums* will not dissolve them ; (3.) which will dissolve any Metal ; and, (4.) which dissolve, respectively, and most exactly.

V O L. III.

T

° Gold will be rusted by the Fumes of *Spirit of Salt.*

P But they have by the Burning-glass. See M. *Homburg's* Paper upon the Subject in the *French Memoirs.*

actly. Observe also, (5.) the Process of the Dissolution ; (6.) the manner of the Liquor's rising, boiling, heating, &c. (7.) the Charge that each *Menstruum* will bear, and then cease to act ; (8.) the Colour it acquires : (9.) above all examine, whether there be any one *Menstruum*, for any one Metal, that is not fretting or corroding ; but opens the Body by *Sympathy*, and not by its Corrosiveness or Violence.

19. Gold dissolves in *Aqua Regia*, into a *yellow Liquor* ; with little Heat or Ebullition : Silver in *Aqua Fortis*, into a *green Liquor* ; unless the Silver were without Alloy ; and this with great Heat and Ebullition. *Mercury* dissolves in the same *Menstruums* as Gold and Silver do, without altering the Colour of the Liquor. Tin likewise, dissolved in salt Water, alters not the Colour of the *Menstruum*. Lead dissolves white, in *Vinegar* ; and leaves the *Menstruum* sweet. Iron dissolves in any sharp, saline, or *vitriolic Water*, and even in common Water ; if the Metal be first calcined with Sulphur : it dissolves Blood-red in *Aqua Fortis* ; with a great Heat and Ebullition. Copper dissolves in the same Liquors as Iron, into a blue. And *Menstruums* may, by Skill, be charged with half their own weight of Metal.

(9.)
The Branching
and Sprouting
of metallic
Solutions.

20. The *Sprouting* or *Branching* of *Metals*, in Solution ; tho it seem but a matter of Pleasure ; has yet a more serious Use : as it discovers the delicate Emotions of Spirits, when they put forth under Confinement ; which is the Case of Vegetables : tho this Shooting of Metals scarce happens, but where the *Menstruum* is over-charged.

(10.)
Hardening
and Softening
of Metals.

21. Under *Hardening* and *Softening*, it must be enquired, what will make *Metals harder*, and what *softer* ; and this Enquiry has two Uses : the *first*, in rendring Metals more manageable by the Hammer, as *Iron* is made malleable by the Fire : the *second*, as *Hardness* is one Step towards *Fixedness* ; and *Softness*, towards *Volatility* : which are Qualities that, by this Enquiry, may give light to one another.

(11.)
Toughness
and Brittleness.

22. *Toughness* and *Brittleness*, tho things of the same kind with *Hardness* and *Softness*, yet deserve a separate Enquiry ; especially with a View of joining *Hardness* and *Toughness* : as in the making *Glass malleable*, and *Sword-blades*, &c. strong, both to resist and pierce, without being liable to break.

(12.)
Volatility and
Fixedness.

23. *Volatility* and *Fixedness*, is a capital Enquiry. The utmost degree of *Fixedness*, is that whereon no Fire will operate, nor *Menstruum* assisted by Fire ; but we don't know that such a *Fixedness* is possible. The next degree is, when Fire, simply applied, will not operate without some *Menstruum*. The next is, by the Test. The next is, by a Fire unblown, or unfanned with a particular Current of Air. The next is, when it will not endure such a Fire ; but yet the Body remains malleable. The next is, when the Body remains brittle ; but stupefied, without flowing. So of *Volatility*, the utmost degree is, when the Body flies off, without returning. The next is, when it flies off, but easily returns. The next is, when it flies upwards,

by

¶ This Affair of the *Sprouting* of *Metals*, or making the *Arbor Diana*, or the *Silver Tree*, as it is vulgarly called, is well prosecuted by M. *Homburg*, and other Members of the *Royal Academy of Sciences* at Paris. See their *History*, and *Memoirs*.

by a kind of Exufflation, without Vapour. The *next* is, when it melts without rising. The *next* is, when it softens without melting. And of all these, especially in the extreme Degrees, careful Enquiry should be made, in the several *Metals*.

24. Under *Transmutation* or *Conversion*, if the Thing be real, and true, 'tis the utmost reach of Art; and should be well distinguish'd from *Extraction*, *Restoration*, and *Adulteration*. There is much talk of converting *Iron* into *Copper*^m; and of the growth and increase of *Lead*; which cannot happen without a *Conversion* of some other Body into *Lead*. (13.)
Transmutation.

25. In *Cyprus* there is said to be a kind of *Iron*, that when cut to pieces, and put into the Ground, will grow into larger pieces, if it be well water'd. *Lead* will multiply and increase; as has been found in old Stone Statues, put in Cellars; the Feet of them being bound with leaden Bands: where, after a time, the *Lead* has swelled so, as to hang upon the Stone like Wartsⁿ. And every thing of this kind, which is clear and well defined, should be carefully enquired into and recorded. (14.)
The Growth of Metals.

ARTICLE III.

Of the Reduction, or Restoration of Metals.

26. Under this *Article*, it should first be enquired, what Bodies will never return; either, by reason of their extreme Fixation, or extreme Volatility. The two *Methods of Reduction* should be carefully examined, viz. that by *Fire*; which is but by collecting the homogeneous Parts together. The second consists in drawing the Bodies downwards, by something that has a Consent therewith: so *Iron* draws down *Copper* in Solution; *Gold* attracts *Quicksilver* in Vapour, &c. and whatever is of this kind shou'd be very carefully enquired into. *The two Methods of Reduction.*

27. It must likewise be examined, how far Time, or Age, will reduce, without the help of Fire, or other Addition. *Whether Time will reduce.*

28. Let it also be enquired, what prevents Union or Restitution; as when *Quicksilver* is kill'd with *Turpentine*, *Sulphur*, &c. *What hinders Reduction.*

29. And *Lastly*, let it be enquired, how the *restored Metal* differs from the *pure Metal*, that has never been destroy'd; or whether it becomes more churlish, altered in Colour, or the like. *Whether Restoration alters the Metal.*

ARTICLE IV.

Of Compounding, Incorporating, or uniting of Metals and Minerals.

30. Enquire, (1.) which *Metals* will unite with which, by barely melting them together; (2.) which thus refuse to incorporate; (3.) in what quantity *What Metals unite.*

T 2

^m The naked Fact is, that at *Newsohl*, in *Germany*, they lay thin Plates of *Iron*, for a certain Time, in a certain running Water; and take them out *Copper*: some whereof I have seen, that was pure *Copper* thro'out. This Fact is mention'd by *Agricola*, *Varenius*, *Hoffman*, *Stahl*, and many more. And whoever would account for it, as the Humour runs, should first consider the *Phænomenon* closely: for there has been much superficial *Verbage* upon the Subject.

ⁿ But is this an actual Growth? Or only a slowing down of the *Lead*, on account of its Softness, and the Pressure acting upon it? See Mr. *Boyle* upon the *Growth of Metals*.

tity they mix ; and (4.) what kind of Body the Compound proves. Thus *Gold* incorporates with *Silver*, in any Proportion ; and, according to *Pliny*, when the *Silver* makes a fifth part of the whole, the Composition is call'd *Electrum* : which remains fixed, ponderous, and coloured, according to the proportion of the two *Metals*.

31. *Gold* easily incorporates with *Quicksilver* ; but the product is imperfectly fix'd : so are all other *Metals* incorporated with *Quicksilver*.

32. *Gold* incorporates with *Lead*, in any Proportion ; so it does with *Copper* ; which is its common Alloy. It likewise incorporates with *Brass* and *Tin* ; which was the ancient Alloy : but with *Iron*, *Gold* will not incorporate °.

33. What is said of *Gold* and *Quicksilver*, holds also of *Quicksilver* and the rest of the *Metals* ; except *Iron*, with which it does not incorporate.

34. *Silver* incorporates with *Lead*, in any Proportion ; as also with *Copper*, *Brass* and *Tin* ; but not with *Iron* : which likewise incorporates with no other Metal. *Lead* incorporates with *Copper* ; and such a mixture was the ancient *Pot-Metal*.

35. It also incorporates with *Tin* ; and a mixture of these two, in equal proportion, was the ancient *Plumbum Argentarium*.

36. *Copper* incorporates with *Tin* ; and of such a mixture were the Mirrors of the *Romans* ^P.

ARTICLE V.

Of the Compound Metals in Use, and the Proportions of their Mixtures.

Pewter, its Composition.

37. Fine *Pewter* consists of a thousand Pound weight of *Tin*, fifty Pounds of *Solder* or *Temper*, and three Pounds of *Tin-glass*. The *Temper* is made of four Pound and a half of the Dross of pure *Tin*, and half a Pound of *Copper*. Coarse *Pewter* is a mixture of fine *Tin* and *Lead*.

Brass:

38. *Brass* is made of *Copper* and *Calamy*, melted together.

Bell-Metal.

39. *Bell-metal* consists of a thousand Pound weight of *Copper* ; from two to three hundred weight of *Tin*, and a hundred and fifty Pounds of *Brass*.

Pot-Metal.

40. *Pot-metal* is *Copper* mixed with *Lead*.

Alchymy.

41. *White Alchymy* is made of a Pound of *Pan-Brass*, and three Ounces of *Arsenick*.

42. *Red Alchymy* consists of *Copper* and *Orpiment*.

Imperfect Metals.

43. There are several imperfect *Metals*, which incorporate with *Metals* ; as *Calmine*, the *Pyrites*, *Mist*, *Chalcitis*, *Sori*, *Vitriol*, &c.

Compositions of several Metals.

44. The *Compositions* of three, or more *Metals*, are too long to enquire into ; unless there be any such Mixtures already in use. It should also be observed, whether any two *Metals*, which will not mix of themselves, may be united by the help of another, or any third Thing ^Q.

Metals to mix with Fossils.

45. Let Trial be made of mixing certain *Fossils* along with *Metals* ; as *Brass* is made by mixing *Calamy* with *Copper*. But *Metals* incorporate not with *Glass* ;

° The Method of Gilding *Iron*, should be here enquired into.

^P And of some such a Mixture may be made the Metal for Reflecting Telescopes.

^Q There are many curious Instances of this in the Sublimar Metallurgy.

Glass; unless themselves be first vitrified. Tho in all Mixtures of this kind, the quantity that comes out should be well considered; because some small matter may incorporate, like the Alloy in Gold and Silver Coin †.

46. Three Things should be principally consider'd, in a Body thus compounded, viz. (1.) the Colour; (2.) the Softness, or Brittleness; and, (3.) the Volatility, or Fixedness, in Comparison of the simple Ingredients.

Three particulars to be regarded in Composition.

47. For *present Use, or Profit*, let it be a Rule, to consider the Price of the two Simples; and again, the Dignity of the one above the other, in Use; then to try if a Compound can be made thereof; whose lowness of Price shall countervail its want of Dignity, in Use. Thus for Example; consider the Price of *Brass-Cannon*, and compare it with the Price of *Iron-Guns*, and observe wherein the former excels the latter, in Use: then if a *compound Metal* for Cannon can be made of *Brass* and *Iron*, that shall be nearly as good in Use, yet much cheaper in Price; it may be attended both with a *private* and *publick Advantage*. So again, notwithstanding the great difference in Price betwixt *Silver* and *Gold*, yet the Dignity of *Gold* above *Silver* is not considerable; their Splendor is equal, and that of *Silver*, more pleasing to some Eyes; as in *Cloth of Silver*, *Silver-Lace*, *Silver-Sword-bills*, &c. The principal Dignity lies here, that *Gold* endures the Fire better than *Silver*; but this is an excellency in Nature, and nothing at all in Use: and it appears to have no superior Dignity except in this, that Things which are silver'd, fully and canker more than those that are *gilded*: which Inconvenience, if it could be prevented, as by a small admixture of *Gold*, might turn to Advantage. 'Tis therefore strange, that the *Electrum* of the Ancients, consisting of *Gold* and *Silver*, should have been disused for so many Ages; whereas it appears a very serviceable mixture in *Coin*, *Plate*, and *Gilding*.

Rules for it in respect of Use and Profit.

48. There seems to be a great difficulty in the *Transmutation* of Metals, or the making of *Gold*, *Silver*, or *Copper* †; on the other hand, there is Deceit, and Villany in the Adulteration and Counterfeiting of them: but there still seems to be a middle way, between the two, by means of *new Compositions*; if the ways of incorporating were but well understood. Let it be enquired, what *Incorporation*, or rather *Imbibition*, Metals will receive from Vegetables, without being dissolved in their Substance; as when the *Armourers* make their Steel more tough and pliable, by sprinkling it with Water; or the Juice of Plants: and when *Gold*, grown eager or churlish, recovers its Softness, and Ductility, by the throwing in of Shavings of Leather, dress'd or drench'd in Oil.

Transmutations difficult.

But new Incorporations practicable.

49. Observe, that in these and the like *apparent Imbibitions*, it were proper to try whether the Weight be increas'd: for if there be no additional Weight, we may suspect there is no *Imbibition* of Substance; but that only the application

Signs of Imbibition.

† He that goes upon reducing this Article to Practice, should be well acquainted with Fossils, and Philosophical Chemistry.

‡ See the Articles, ALTERATIONS, GOLD, and TRANSMUTATION.

cation of the other Body disposes and ranges the *Metal* in another situation of Parts, than of itself it would have taken †.

The Incorporation of Metallic Solutions.

50. After the *Incorporation of Metals*, by *simple Fusion*, the *Incorporation of their Dissolutions* should be likewise tried; the better to discover their Natures, Agreements, and Disagreements: and shew what Metals, when dissolved in their Menstruums, will incorporate kindly together, and what not: and to this purpose, particular Enquiries should be separately made; as before in the Business of *Smelting*, or *Colliquification*.

Their Agreement or Disagreement.

51. In such *Solutions* as do not easily incorporate, the Effects should be observed; as, whether there is (1.) any *Ebullition*; (2.) *Precipitation* to the Bottom; (3.) rising up towards the Top; (4.) a Suspension in the middle; and the like. Thus the *Solutions* of *Gold* and *Silver* disagree; so that when mixed together, they cause great *Ebullition*, *Darkness*, and at length *precipitate* a black Powder; so likewise the *Solutions* of *Silver* and *Copper* disagree; as likewise those of *Silver* and *Lead*: but the *Solutions* of *Gold* and *Mercury*, and those of *Silver* and *Tin*, agree. The *Solution* of *Gold*, likewise agrees with that of *Iron*; and the *Solutions* of *Mercury* and *Iron* agree with all the rest †.

Whether the Disagreement be owing to the Menstruum or the Metal.

52. Observe, that the disagreement of the *Menstruums* may prevent the Incorporation, as well as the disagreement of the *Metals*: and therefore where the *Menstruums* are the same, and yet the Metals do not incorporate, the difference must be in the *Metals*; but where the *Menstruums* are different, this is not so certain.

ARTICLE VI.

New Compositions of Metals.

Of incorporating stony Matter with Iron.

53. Let Trial be made, whether *Iron* will incorporate with any stony Matter; for if it will, without too great Charge, or other Inconvenience; the cheapness of the stony Matter, may render the *Composition* profitable, and fit for various Uses. But such a Composition, tho it may serve for ordinary Uses, and the large Works, as Stoves, Guns, Portcullises, &c. cannot well be expected fit for the finer Works; as *Locks*, *Clocks*, *small Chains*, &c.

Iron and Brass.

54. Let Trial be made of incorporating *Iron* and *Brass*; for the cheapness of *Iron* in Comparison of *Brass*, promises Profit; if the Uses may be served. But such an Incorporation is not to be expected, upon *simple Fusion*; or without some particular Calcination, or Addition. If such a compound Metal would come sufficiently cheap, it might serve for *Ordnance*, *Statues*, *Columns*, *Monuments*, and the like. The Experiment might be tried with *Brass*, *Iron*, *Calamy*, and *Sulphur*; with a small addition of *Lead*: tho the Expence is first to be consider'd, lest it should eat out the Profit †.

54. There

† This belongs to the *Sublimar Metallurgy*; which lies in so few Hands, and has been so obscurely treated, that the generality of Philosophers know not what to believe about it.

‡ Many Secrets probably lie concealed in this part of the Enquiry.

§ There are a few considerable Hints to this purpose, in the *Philosophical Transactions*, and *French Memoirs*.

55. There are two Trials to be made in the Incorporation of Metals, for Magnificence and Delicacy; the one with regard to the Eye, the other with regard to the Ear; viz. the one for *Statue-Metal*; and the other for *Bell-Metal*, *Trumpet-Metal*, and *String-Metal*: and tho the mixture should here be dearer than *Brass* itself, yet the agreeableness or excellence of the *Metal*, may advance the Price, to Profit. First, therefore, for *Statue-Metal*, see *Pliny's* mixtures, which are almost forgot; and consider the Charge. Try likewise the mixture of *Tin*, in a large Proportion, with *Copper*; and observe the Colour and Beauty when polish'd.

New Com-
pounds for
Statue-Metal.

56. For *Bell-Metal*, try a mixture of pure *Iron*, and *Glass*, and *Tin*; if a Method can be found to make them unite; with a mixture of *Silver*. And do the same for *String* and *Trumpet-Metal*; only omitting the *Glass*. Try to incorporate *Silver* and *Tin*, in equal Quantities; and two parts of *Silver* with one of *Tin*: and observe whether the *mixed Metal* be of equal Beauty, and Lustre with *Silver*; and whether it yield no more Sullyness; and again, whether it will endure the ordinary Fire, like *Silver Vessels*, without melting. For, if in these respects it were equal to *Silver*, it would be a thing of singular Use and Profit: tho perhaps it might not receive Gilding, as *Silver* does.

For Bell-Me-
tal, String-
Metal, &c.

57. Enquire into the ways of *Drowning one Metal* in another, so as never to rise again. By *Drowning*, I understand the mixing of a baser Metal with a nobler, so that they can by no means be separated. This *Drowning of Metals* is a kind of *Version*, tho false: as if *Silver* should be inseparably incorporated with *Gold*; or *Copper*, and *Lead*, with *Silver*. The ancient *Electrum* had, as was before observ'd, a fifth of *Silver* to the *Gold*, and made a compound *Metal*; as fit for most Uses as *Gold*. It was more resplendent, and better qualified in some other respects; but then the two were easily separated. I have heard a Man, skilful in Metals declare, that a fifteenth part of *Silver* incorporated with *Gold*, cannot be recovered by any *Water of Separation*; unless you add a greater quantity of *Silver* to draw the less to it: which he said is the last Refuge in Separations. But this is a tedious way, that few would think on. The Fact should be enquired into: and the quantity of a fifteenth turned to a twentieth, with some little addition; that may further the intimate Incorporation. Note, that *Silver* in *Gold* will be detected by the want of specifick Gravity; but not *Lead* in *Silver*: because *Lead* is heavier than *Silver*.

Of Drowning
Metals.

58. This *Drowning of Metals*, would be a thing of great Profit: for if a quantity of *Silver* could be so buried in *Gold*, as not to be reduced back by Fire, *Depart-Waters*, or otherwise; and yet the mixture serve all Uses, as well as *Gold*; 'tis, in effect, the same thing as converting so much *Silver* into *Gold*: only the Gravity will discover it; tho this takes off but half the Profit: for *Gold* is not double the Weight; but twelve times the price of *Silver*.

59. This

* See *Faschius's Prober-Buchlein*; and *Strahl's Philosophical Principles of Chemistry*, pag. 282, &c.

59. This *Drowning of Metals* may be attempted two ways ; viz. either in a very small Proportion, or with something that may fix the *Silver* in the body of the *Gold* : for the less quantity is always hardest to separate. And for the Business of fixing ; it may be proper to use *Bone-Asbes*, or *Cupel-Dust*, or the like Body, which the Fire has no power to consume.

The making of
Gold and Sil-
ver.

60. The making of *Gold* is a desperate *Project*, because *Gold* is the heaviest of Metals ; to make Matter impossible ; and to condense Metals, a thing hardly to be hoped for. But the making of *Silver* might more rationally be attempted ; because both *Quicksilver* and *Lead* are heavier than *Silver* ; so that they require only fixing, and not condensing. The nearest Approximation yet known, is the plunging of *Quicksilver*, tied up in Parchment, or otherwise, in melted *Lead*, whilst it cools ; for this stupefies and coagulates the *Quicksilver*. The Experiment may, perhaps, be improved three ways ; (1.) by melting the *Lead* again and again ; to see if it will not make the *Quicksilver* still harder, and harder : (2.) by putting *Realgal*, hot, into the midst of the *Quicksilver* ; whence it may be coagulated as well from within, as without ; and (3.) by trying it over melted *Iron* ; to see if this will not fix the *Quicksilver* more than *Lead* ².

M I L K.

Of increasing
of Milk in Cat-
tle.

There is a kind of Stone, which they grind to Powder, and put into Water, whereof Cattle drink, to make them give more Milk : and there should be some better Trials made of mixtures of Water in Ponds for Cattle, to increase their *Milk*, or fatten them, or keep them from the Murrain. Perhaps Chalk and Nitre are proper ¹. See the *Article* PRESERVATION, § 2.

M I X T U R E.

Experiments
upon the simple
Commixture of
Liquors with-
out Heat.

1. *Spirit of Wine*, tho much lighter than Oil, mixes with common Water : but if its Fall be broke by the Interposition of a linen Rag, or the like,

* 'Tis very observable, that here is a noble *Philosophical Foundation* laid for the *History of Metals* : But certainly there are few who take in the Nature, the Extent, and Uses of such a *History* ; otherwise we might reasonably expect, more should have been done in it. The Misfortune lies here, that *Metallurgy* is almost wholly left to mechanical Hands ; whilst very few such able Chemical Philosophers as *Becher* and *Stahl* concern themselves about it.

† Some use *Malt-Dust*, for this purpose, made of a pappy Consistence with warm Water. But the *History of the Dairy* is greatly wanted in *Natural* and *Experimental Philosophy*. This *History* might serve as a Key to many other Enquiries. But it seems so low and vulgar a Thing in the Eyes of many ; that those who are otherwise disposed to enter upon it, are hence discouraged from the Undertaking. Yet the Profit that would probably attend the Enquiry, might encourage some to undertake it, who are incapable of being influenced by other Motives. To have a double Produce of *Dairy Productions* from the same quantity of Milk, is no trifling Advantage. And are the best ways of making those ordinary Commodities, *Cheese* and *Butter*, discover'd ? Cou'd not these Preparations be more gratefully colour'd and flavour'd, at an easy Expence ? Cou'd not the Yield be greatly increased ? Cou'd not the refuse Liquors be turn'd to a much more considerable Advantage than at present ? And, in particular, could not wholesome potable Liquors, or a kind of Wines, and *Brandies*, be prepared from *Whey* ? These Things are worth examining, by such as are skilled in *Chemical Operations*.

like, it remains floating a-top : yet if once mix'd, it does not, like Oil, separate again. This I try'd in Water tinged with Saffron.

2. *Spirit of Wine* does not mix readily with Water ; but makes a kind of clouding and waving. This was likewise tried with Saffron-water².

3. Having dissolved a Dram of *Gold* in twelve times its Quantity of *Aqua regia*, and a Dram of *Copper* in six times its Quantity of *Aqua fortis* ; the Solutions, when put together, exhibited a green Colour ; without any visible Motion in the Parts.

4. *Oil of Almonds*, mix'd with *Spirit of Wine*, separates again ; the *Spirit* floating a-top, and the *Oil* resting at the bottom.

5. A Dram of the *Solution of Gold*, mixed with an equal quantity of *Spirit of Wine*, gives no apparent Alteration.

6. The *Solution of Quicksilver*, and the *Solution of Gold*, each in the quantity of a Dram, turn to a kind of mouldy Liquor, black, like Smithy-water. In this Case, the *Solution of the Gold* was twelve parts *Menstruum*, and one part Metal ; and that of *Quicksilver* was two parts *Menstruum* to one of Metal.

7. *Spirit of Wine*, and the *Solution of Quicksilver*, being put together, each in the quantity of a Dram ; at first threw up a white milky Substance to the top ; but mixed soon after.

8. A Dram of *Oil of Vitriol*, mix'd with a Dram of *Oil of Cloves*, turns of a dark red Colour, and forms a thick Substance, almost like Pitch ; and upon the first Motion, conceives an extreme Heat, not to be endured by the Hand.

9. A Dram of the *Solution of Gold*, and as much *Oil of Vitriol*, gathers a great Heat, at first ; and makes a thick, muddy Liquor.

10. *Spirit of Wine*, and *Oil of Vitriol*, each in the quantity of a Dram, scarce mix at all ; the *Oil* sinking to the bottom ; and the *Spirit* resting, milky, above. The *Spirit*, however, conceives a great Heat ; and becomes sweet to the Taste.

11. A Dram of *Oil of Vitriol*, and as much *Solution of Quicksilver*, makes a violent struggle ; throws up a gross Steam, and afterwards precipitates a white kind of Curds or Sand : a slimy Substance rising to the top, and conceiving a great Heat.

12. A Dram of *Oil of Sulphur*, and as much *Oil of Cloves*, turn into a thick and red Substance ; tho without conceiving such a Heat as *Oil of Cloves*, and *Oil of Vitriol*.

13. *Rock-Oil*, and *Spirit of Wine*, each in the quantity of a Dram, intermix as Wine and Water do, by Agitation ; otherwise the *Rock Oil* remains a-top.

14. *Oil of Vitriol*, and *Rock-Oil*, each a Dram, turn into a mouldy Substance, and conceive some Heat ; whilst a black Cloud falls to the bottom, and a very thick Oil rises to the top.

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² These Experiments occur among the Author's *Physiological Remains* ; and probably were not intended to be published without some Introduction, to have shewn their Tendency and Use.

15. An Ounce of *Spirit of Wine*, and as much *Wine-Vinegar*, mix by Agitation, without manifestly separating again ; but at the first fall, the Spirit remains above.

16. *Oil of Vitriol*, and *Oil of Almonds*, each an Ounce, mix not ; but the Oil of Almonds remains a-top.

17. A Dram of the *Solution of Iron*, and as much of *Oil of Vitriol*, first precipitate a milky Substance ; and then incorporate into a mouldy one.

18. One part of *Spirit of Wine*, put to two parts of *Milk*, coagulates a little ; but mixes : and the Spirit does not float a-top.

19. Equal quantities of *Milk* and *Oil of Almonds*, will hardly incorporate ; but the Oil floats above, when the Milk is poured to it : and the Milk appears in Drops or Bubbles.

20. A Scruple of *Oil of Vitriol*, put to an Ounce of *Milk*, coagulates it at the bottom, where the *Oil of Vitriol* lies.

21. *Oil of sweet Almonds*, and a *Solution of Gum Tragacanth*, do not mix ; but the Oil remains above, till they are stirr'd : and this makes the Mucilage somewhat more fluid.

22. Half an Ounce of *Spirit of Wine*, being stirr'd in with an Ounce and a half of the *Solution of Gum Tragacanth*, renders the Mucilage thicker.

23. The *White of an Egg*,* being put into *Spirit of Wine*, coagulates and hardens, as if the Egg began to poach.

24. An Ounce of *Blood* easily incorporates with an Ounce of *Milk*.

25. An Ounce of *Blood*, and an Ounce of *Oil of Almonds*, do not incorporate ; but the Oil floats above.

26. *Spirit of Wine* curdles or coagulates *Blood*.

27. An Ounce of unclarified *Whey*, being put to an Ounce of *Oil of Vitriol* ; there appears no visible Alteration.

28. Three quarters of an Ounce of *Wax*, being dissolved upon the Fire, and an Ounce of *Oil of Almonds* put to, and stirr'd with it ; they do not so incorporate, but that when cold, the *Wax* collects, and floats upon the Oil.

29. An Ounce of *Oil of Almonds*, being put to an Ounce of boiling *Sugar* ; they presently separate ; the *Sugar* shooting towards the bottom ^a.

MOON.

Of the Influences of the Moon.

The *Influences of the Moon* are chiefly four ; viz. (1.) the calling forth of Heat ; (2.) the introducing of Putrefaction ; (3.) the increasing of Moisture ; and (4.) exciting the Motions of the Spirits.

(1.) For

^a These are but scatter'd or undigested Experiments, relating to a Subject of great importance in *Physicks*, as particularly in *Pharmacy* and *Chemistry* ; viz. the Agreement and Disagreement of Bodies, with regard to their mixing or uniting. It were, therefore, proper to prosecute them in *Sets* or *Classes* ; till they pointed out the *Axioms*, or just Doctrine of *Mixture*, in all kinds of Fluids : whereby the Doctrine of Menstruums, and Chemistry itself, might receive considerable Improvement. Something towards this Design has been done by Mr. Boyle, M. Geoffroy, and Dr. Stahl : But the Doctrine of *Mixture*, in the proper physical Sense, seems very little understood ; tho its Foundations were laid by Becher, and have been since illustrated and improved by Stahl.

(1.) For drawing forth Heat ; take warm Water, and expose part of it to *As to Heat.* the Moon-Beams ; and part of it with a Skreen between ; to see whether that which stands exposed to the Beams, will not cool sooner. But because this is only a small Interposition, it were proper to try it, both when the Moon shines, and when she does not ; and with warm Water in a glass Bottle, as well as in a Dish ; and with Cinders, red hot Iron ^b, &c.

(2.) For introducing of *Putrefaction* ; try it with Flesh, or Fish, exposed to the Moon-Beams ; and again exposed to the Air, when the Moon does not shine ; for the like time : to see which will corrupt the soonest. Try it also with Capon, or other Fowl, to see which will become tender sooner. Try it with dead Flies or Worms, casting a little Water upon them ; to see which will putrefy first. Try it with an Apple, or Orange, having Holes made in them ; to see which will rot, or grow mouldy soonest. Try it with Cheese, having Wine put into it ; to see which will breed Mites or Maggots sooner, or larger ^c.

(3.) For the increase of *Moisture* ; the received Opinion is, that Seeds, Hedges, Herbs, Hair, Nails, &c. grow quickest if set, or cut, in the increase of the Moon : also that the Brains of Rabbits, Woodcocks, Calves, &c. are plumpest in the full of the Moon : and so of Marrow in the Bones, and the Bodies of Oysters and Cockles ^d. Set any Seeds, or Roots, some of them immediately after the Change, and others, of the same kind, immediately after the Full ; in the same Earth, or in Pots : let the Pots also stand where no Rain or Sun can come at them ; lest the difference of the Weather confound the Experiment : and see in what time the Seeds set in the increase of the Moon, come to a certain height, and how they differ from those set in the decrease. Probably the Brain of Man grows moister, and more turgid at the Full of the Moon : it were therefore proper for those that have moist Brains, or are great Drinkers, to take the Fume of *Lignum Aloes*, Rosemary, Frankincense, &c. about the Full of the Moon. The Humours also in Mens Bodies may increase and decrease with the Moon ; whence it were convenient to purge a Day or two after the Full ; for then the Humours will not replenish so soon again.

(4.) As for exciting the Motion of the Spirits ; observe that the growth of Hedges, Herbs, Hair, &c. is caused from the Moon, by exciting the Spirits, as well as by increasing the Moisture. But for the Spirits in particular, the great INSTANCE ^e is in Lunacies. There may be other secret Effects of the influence of the Moon, not yet brought under Observation ^f.

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Per-

^b Have these Experiments been made, with Care and Accuracy ? Or have not Philosophers, from their Theories, generally thought them too trifling to be tried ?

^c There have been strange Things related of this Operation of the Moon : but I do not find them verified.

^d Are the Facts here mention'd, determined to this Day ; any farther than by a general Application of the Doctrine of the Tides, as caused by the Moon, to all Fluids, as well as the Sea-Water ?

^e See the Doctrine of INSTANCES, in the *Novum Organum*, Part II.

^f See Mr. Boyle's *Apology for Astrology*, in his *Memoirs for a general History of the Air*. See also the *De Augment. Scientiar.* Sect. IV.

Perhaps if the Wind be North, or North-East, in the Full of the Moon, it increaseth Cold; and if South, or South-West, it disposes the Air, for a considerable time, to Warmth and Rain: which should be observed. Probably Children, and young Cattle, that are generated or brought forth, in the *Full* of the Moon, are stronger and larger than those brought forth in the *Wane*: if so, it might be good Husbandry to put Rams and Bulls to the Females, somewhat before the *Full of the Moon*. Perhaps, also, Eggs laid in the Full of the Moon, breed the better Birds; and many of the like Effects may be brought into Observation. *Quære* also, whether Thunders, and Earthquakes, happen not most in the Full of the Moon^g.

M O T I O N.

Motion of Gravity and Levity.

1. The Ancients call'd the *Motion of Gravity* and *Levity* by the Name of *natural Motion*; because they perceived no external Efficient thereof, nor any apparent Resistance: and it also seem'd to be very quick in its Progress. This insipid Conceit has borrowed some Seasoning from that *Mathematical Notion* of the Adhesion of heavy Bodies to the Earth's Centre, in Case the Earth were perforated; and again, from that *Scholastic Fiction* of the Motion of Bodies to their own places. And when Men had laid down this, they thought they had done the Business; and looked out no farther: except here and there one, who more diligently enquired out the *Centre of Gravity* in Bodies of different Figures; and the Motion of Bodies in Water. Nor have the Moderns perform'd any thing to purpose upon this Subject; besides adding a few mechanical Discoveries; and those too distorted and perverted by their Demonstrations. But for the Thing itself; 'tis certain, that *Body* can suffer from nothing but *Body*; and that no local Motion can happen without an exciting Cause, proceeding either from the Parts of the Body moved; the adjacent, contiguous, or approaching Bodies; or, at least, such as lie within their Sphere of Activity. It was not, therefore, amiss in *Gilbert* to introduce *magnetical Virtues*; only himself also became Magnetical, and drew too many Things by those Virtues; so as to build a *Ship* out of a single *Stick*^h.

Motions by Imitation.

2. Motions pass from one Man to another, not so much by exciting the Imagination, as by Imitation; especially if there be an aptness or inclination before. Whence, Yawning and Stretching pass from Man to Man; being caused, when the Spirits are a little heavy, or oppress'd, by any Vapour, or the like; whilst the Spirits strive, as it were, to wring out and expel that which oppresses them. So Men drowsy, and desirous to sleep, or before the Fit of an Ague, usually yawn and stretch; sending out at the same time a Voice or Sound, which is a natural *Interjection of Expulsion*: so that if another be prepared to do the like, he follows by Aspect: and thus the laughing of one Person, makes another laugh, &c. See the *Article* SYMPATHY.

3. Birds

^g We have here the Foundation of a very important Enquiry, wherein *Natural Philosophy*, *Medicine*, *Agriculture*, *Husbandry*, &c. are nearly concerned. And yet this Enquiry lies strangely neglected; so that in the Matters relating to it, we proceed upon *Rumours*, and *Traditions*, instead of sound *Experience*, and well digested *Observation*.

^h This was design'd as an *Introduction* to the *particular History of Gravity and Levity*; but the *Work* was never published.

3. Birds move swifter than Beasts; because, the Stock of Spirits in Birds may be greater, in proportion to the Bulk of their Bodies.

The quickness of Motion in Birds. Experiments relating to the Motion of Bodies upon Pressure.

4. Put Water into a Glass; wet your Finger, and draw it round the edge of the Glass, somewhat hard; and the Water will frisk, and sprinkle up, in a fine Dew. This shews the Force of Compression in a solid Body: for whenever a Solid is press'd, there is an inward Tumult in the Parts thereof, tending to deliver themselves from the Compression: and this is the CAUSE of all violent Motion. It is very strange that this Motion has never been observed, and enquired into; as being the most common, and the chief Origin of all mechanical Operations.

5. This Motion operates first in a Round, by way of Proof and Trial, which way to deliver itself; and then in Progression, where it finds the Deliverance easiest^b. In Liquors, this Motion is visible; for all Liquors when struck, make round Circles, and dash: but in Solids it is so subtle, as to be invisible; yet manifests itself by many Effects, as in the present Instance. For the Pressure of the Finger, promoted by the wetting, soon sets all the small Parts of the Glass at work; so that they strike the Water briskly: whence proceeds the sprinkling.

6. If you strike a solid Body, that is brittle; as Glass, or Sugar; it breaks not only in the part where the immediate Force acted; but shivers every way: the Motion here searching in all Directions, and causing the Body to break where it was weakest.

Upon Percussion.

7. Gunpowder, fired from a Cannon, and thus dilated into Flame, that does not endure Compression, moves likewise in a Round; (as being of the nature of a Fluid;) sometimes recoiling; sometimes breaking the Piece; but generally discharging the Bullet: because it there finds the least Resistance.

In the Firing of Gunpowder.

8. This Motion upon Pressure, and its reciprocal viz. Motion upon Tension, we call *Motion of Liberty*; that is, when a Body, being forced to a preternatural Extent, delivers, and restores itself to the natural: as a blown Bladder, when press'd, rises again; or Leather, or Cloth, when stretch'd, springs back. This Motion upon Pressure, is manifest also in Sounds; as when a Bell is struck: but as soon as the Hand is pressed upon it, the Sound ceases: so, the Sound of a Virginal-string stops when the Quill of the Jack falls down. For these Sounds are produced by the subtle Percussion of the minute Parts of the Bell, or String, upon the Air; as Water is made to leap, by the subtle Percussion of the minute Parts of the containing Glass^c. See the *Articles GRAVITY and IMPULSE*.

Motion of Liberty.

MUSIC.

^b The Author's Doctrine of Sense and Sensibility, ought to be remembered on this, and many other Occasions: otherwise some of the modern Philosophers may imagine, he attributes mental Properties to Matter. See *De Augment. Scientiar.* Sect. X. 9—11. See also the *Article DIVINATION*, above.

^c See Motions classed in the *Novum Organum*, Part II. Sect. II.

^k The *Doctrine of Motion*, so far as it is here considered, seems to have received very little Improvement since the time of our Author. And tho' the general Subject of Motion has been laudably

MUSICK.

A Specimen of
a proper En-
quiry into
Musick.

1. The *Practice of Musick* has been well pursued ; and in good variety : but the *Theory* weakly ; especially as to assigning the *Causes* of the *Practice* : being also reduced to certain mystical Subtilties, of no Use, and but little Truth. We shall, therefore, after our manner, here join the *Theoretical* and *Practical* Parts together ¹.

Sounds divided
into Musical
and Immusi-
cal.

Tones what
in the physical
Sense.

2. All Sounds are either *musical*, or *immusical*. The *musical* are otherwise call'd *Tones* ; which may be accompanied with a *Harmony* ; and are ever equal ; as in *Singing*, the *Ringing* of Bells, &c. But the *immusical* Sounds are ever *unequal* ; as the Voice in Speaking, Whispering, all Percussions of Stone, Wood, Parchment, Skins, &c. The Sounds that produce *Tones*, always arise from such Bodies, as are equal ; in their Parts and Pores such are the Percussions of Metal, as in Bells ; of Glass, as in the filling of a Drinking-Glass ; of Air, as in Mens Voices, whilst they sing ; in Pipes, Organs, stringed Instruments, &c. and of Water, as in the Nightingal-Pipes of Organs ; and other hydraulick Machines used by the Ancients, but now lost. And if any Man think, that the *String of the Bow*, and the *String of the Viol*, are neither of them equal Bodies, and yet produce *Tones* ; it is a Mistake : for the Sound is not created between the *Bow* and the *String* ; but between the *String* and the *Air*. Whence there are, in effect, but three Percussions that create *Tones* ; viz. (1.) The *Percussion of Metals*, comprehending Glass, and the like ; (2.) the *Percussion of Air* ; and (3.) the *Percussion of Water*.

Produced by
three Percus-
sions.

The Diapason
what.

3. The *Diapason*, or *Eighth* in *Musick*, is the sweetest *Concord* ; being in effect an *Unison* : as we see in *Lutes*, that are double-strung in the bass Strings, one an *Eighth* above the other ; both which make but as it were one Sound. And every *eighth Note* in Ascent, as from *eight to fifteen*, from *fifteen to twenty two*, and so on in *infinitum*, are but Scales of the *Diapason*. The Cause is dark ; and has not been hitherto assign'd. It seems that *Air*, the medium of Sounds, admits of great variety in them : as we see in the Voices of living Creatures ; and several Men, who are discernable by their Voices ; and in the Combination of Letters, whence articulate Sounds proceed ; which of all others are most various. But in the Sounds that are always equal, that is *Tones*, the Air is unable to cast itself into any such variety ; but is forced to recur into one and the same Figure, only differing in *greatness* and *smallness* : as Figures, may be made of Lines, crooked and strait, in infinite variety, where there is inequality ; whilst *Circles*, *Squares*,
or

The Cause of
Unisons in e-
very eighth
Note.

laudably cultivated, by the later *Mathematicians* ; perhaps there still remain many Particulars in it, pointed out by the Lord Bacon, which neither they, nor the modern *Philosophers*, have duly prosecuted. See the *Novum Organum*, Part II. Sect. II. and the Doctrine of Motion and moving Principles, in the *Philosophia Prima* hereafter, Vol. III.

¹ Professed Musicians seldom regard more than the *Practice* ; and *Philosophers* seldom more than the *Theory of Musick* : whence few seem to have aim'd at giving a just *History* of the Subject ; that should at once satisfy the Mind, with *Causes* ; and lead to farther Improvements, in *Practice*.

or *equilateral Triangles*, which are all Figures, can differ only as to great or less ^m.

4. But what shews there is nothing in the *number Eight*, to create the *Diapason*; this *Computation of Eight* is a Thing rather *received* than *true*: for a *true Computation* should always be by distribution into equal Proportions. Now there intervene, in the rise of *Eight*, two *Bee-Molls*, or *half Notes*: so that to divide the *Tones* equally, the *Eight* is but *seven whole* and *equal Notes*: and to subdivide that into half Notes, as in the Stops of a Lute, it makes *thirteen*. Yet in the ordinary *Rises* and *Falls* of the human Voice, (not measuring the Tone by whole Notes, and half Notes, which is the equal measure) there are also two *Bee-Molls* between the *Unison* and the *Diapason*: and this *variation is natural*. For if a Man would endeavour to raise or fall his Voice, by half Notes, like the Stops of a Lute, or by whole Notes alone, without halves, as far as an Eighth; he cannot do it: which shews, that *after every three whole Notes, Nature requires, for all harmonical Use, one half Note to be interposed*. *That the Effect is not owing to the Number.*

5. Again, whatever Virtue there is in *Numbers*, conducing to concert in Notes, it should be rather ascribed to the *ante-Number*, than to the *entire Number*; because the Sound returns after *six*, or after *twelve*; so that the *seventh* or the *thirteenth* is not the Thing, but the *sixth* or *twelfth*: and the *seventh* and *thirteenth* are but the Limits and Boundaries of the Return.

6. The *Concords in Musick*, which are perfect, or semiperfect, between the *Unison* and the *Diapason*, are (1.) the *fifth*; which is the most perfect; (2.) the *third*; (3.) the *sixth*, which is more harsh; and (4.) according to the Ancients, and some Moderns, the *fourth*, which they call *Diatefferon*. As for the *tenth*, *twelfth*, *thirteenth*, and so on in *infinitum*, they are but Recurrences of the former; viz. of the *third*, the *fifth*, and the *sixth*; being an *Eighth* respectively from them. *The Concords in Musick.*

7. For *Discords*; the *second* and the *seventh* are, of all, the most disagreeable in Harmony; the one being next above the *Unison*, the other next under the *Diapason*: which shews, that *Harmony requires a competent Distance of Notes*. *The Discords.*

8. In *Harmony*, if there be no *Discord* to the *Bass*, it does not disturb the Harmony, tho there be a *Discord* to the higher Parts; provided the *Discord* be not of the two that are odious: and therefore the ordinary *Concert* of four Parts, consists of an *Eighth*, a fifth and third to the *Bass*: but that *fifth* is a *fourth* to the *Treble*, and the *third* is a *sixth*. The Reason is, that the *Bass* striking more Air, overcomes and drowns the *Treble*; unless the *Discord* be very disagreeable, and so covers a small Imperfection: As we find one of the lower Strings of a *Lute*, gives not the Sound of the *Treble*, or any mixt Sound, but the Sound of the *Bass*. *The Doctrine of Bass and Treble.*

9. We have no *Musick of Quarter-Notes*; and perhaps they are not capable of Harmony: for the *Half-Notes* themselves do but sometimes interpose. Yet we have some *Slides* or *Relishes* of the Voice, or String, as it were, *No Musick of quarter Notes.*

^a Being Similar Figures, as the Geometricians call them,

were continued without Notes, from one *Tone* to another ; rising or falling ; which are delightful.

The Cause of Harmony.

10. We may receive some light, with regard to the *Causes* of what is pleasing or displeasing to the Ear, from what is so to the Sight. There are two things pleasing to the Eye ; viz. *Colours* and *Order*. The pleasure of *Colour* symbolizes with the pleasure of any single *Tone* ; but the pleasure of *Order* symbolizes with *Harmony*. Therefore in *Garden-knots*, the Frets of Houses, &c. equal Figures, as *Globes*, *Pyramids*, *Cones*, *Cylinders*, &c. are pleasing ; whilst unequal *Figures* are but Deformities. And the pleasures both of the *Eye* and of the *Ear*, are but the effects of Equality, good Proportion, or Correspondence : so that, without question, *Equality and Correspondence are the CAUSES of Harmony* °.

Why musical Sounds are more wakeful than others.

11. *Tones* are not altogether so apt to procure Sleep, as some other Sounds ; viz. the *Wind*, the purling of *Water*, the humming of *Bees*, &c. The Reason is, because *Tones*, being equal, and not sliding ; strike and prick the Sense more than the other : and Attention always hinders Sleep.

Musick has its Tropes and Figures.

12. There are in *Musick* certain Tropes or Figures, almost like those of *Rhetorick* ; and agreeing with the Affections of the Mind, and the other Senses. Thus, the *Division* and *Quaver*, which please so much in *Musick*, have an Agreement with the glittering of *Light* ; as when the Moon-beams play upon a Wave. Again, the falling from a *Discord* to a *Concord*, which makes great Sweetness in *Musick*, has an Agreement with the Affections, that are gratefully reinstated, after some Dislike : it agrees also with the Taste ; which is soon glutted with what is sweet alone. The sliding from the *Cloze* or *Cadence*, agrees with that Figure in *Rhetorick* called *præter Expectatum* ; for there is a Pleasure even in being deceived. The *Reports* and *Fuges* agree with those Figures in *Rhetorick*, called *Repetition*, or *Traduction*. The *Tripla's*, and changing of *Times*, agree with the *Changes of Motions* ; as when galliard Time and measure Time, meet in the Medley of one Dance.

Whence the great Influence of Musick upon the Mind.

13. It has been anciently observed, that the *kinds of Musick have a great Operation upon Men's Manners* ; so as to rouse the Courage, or make them warlike : and again, soft or effeminate ; grave or light ; gentle, and inclined to pity, &c. for the *Sense of Hearing* strikes the Spirits more immediately than the other Senses do, and more incorporeally than the *Smelling* : the *Sight*, *Taste*, and *Feeling*, having not their Organs so suddenly and immediately accessible to the Spirits, as the *Hearing* has. The *Smell*, indeed, works also immediately upon the Spirits ; and is forcible while the Object lasts ; but it comes only with a Communication of the Breath, or the Vapour of the Object : whereas *Harmony* entring easily, without mixing at all ; and coming with a manifest Motion ; it, by the custom of often affecting the Spirits, and putting them into one kind of Posture, greatly alters their Frame, even when the Object is removed. Whence *Tunes*, and *Airs*, even in their own Nature, have some Affinity with the Affections ; as there

° See Mr. Hutchinson's Enquiry into our Ideas of Beauty and Virtue.

there are *merry Tunes*, *doleful Tunes*, *solemn Tunes*, *Tunes inclining to Pity*, *warlike Tunes*, &c. no wonder, therefore, if they alter the *Spirits*; considering that *Tunes* in themselves have a Predisposition to the Motion of the *Spirits*. But it has been noted, that tho' this variety of *Tunes* disposes the *Spirits* to a variety of Passions conformable to them; yet, generally, *Musick* feeds that Disposition of the *Spirits* which it finds. We see also, that different *Airs* and *Tunes*, please different Nations and Persons; according to the *Sympathy* such *Tunes* have with their *Spirits* ^p. See the *Article* *SOUNDS*.

N.

N A T U R E.

1. **T**HE Knowledge of Man has hitherto been determined by the Sight; so that whatever is invisible, either in respect of the Fineness of the Body itself; the Smallness of its Parts; or the Subtily of its Motion; is little enquired into ¹: yet these are the things that principally govern *Nature*, and, without which, we can have no true *Analysis*, and Indication of her Proceedings. The *Spirits* residing in all tangible Bodies are scarce known, and sometimes Men take them for a *Vacuum*; whereas they are the most active of Bodies. Sometimes, again, these *Spirits* are taken for *Air*; from which they differ, as much as *Wine* from *Water*; or *Wood* from *Earth*. Sometimes Men will have them to be *natural Heat*, or a Portion of *elementary Fire*; tho' some of them are crude and cold. Others will have them to be the *Virtues* and *Qualities* of the tangible Parts; which they see: whereas they are things by themselves. Others, in treating of *Plants*, and *Animals*, call these *Spirits*, *Souls*: and such superficial Speculations Men have; like *Perspectives*, which shew things hollow that are only *Paintings*. *The Variety of Opinions about the Spirits of Bodies.*

2. Nor is this a Question of Words, but infinitely material in Nature: for *Spirits* are no other than a *natural Body*, rarified to a certain degree, and included in the tangible Parts of Bodies, as in a Cover. They are no less different from one another, than the dense or tangible Parts: and they reside more or less in all tangible Bodies: they are scarce ever at Rest: and from them, and their Motions, principally proceed *Aresaction*, *Colliquation*, *Concoction*, *Maturation*, *Putrefaction*, *Vivification*, and most of the Effects of *Nature*: for tangible Parts, in Bodies, are stupid Things; whilst the *Spirits*, in effect, do all ¹. *Spirits; their Nature and Properties.*

3. As to the Differences in the tangible Parts of Bodies, the Chemists have given us some light; in distinguishing, by their Separations, between the *oil*, *crude*, *pure*, *impure*, *fine*, and *gross* Parts of Bodies. And Physicians acknowledge, that *Herbs* and *Drugs* have different Parts; as that *Opium* has

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a

The Difference of tangible Parts in Bodies.

^p Here is a Foundation laid for a philosophical History of *Musick*; a thing, perhaps, still wanting, in its due Form and Extent; notwithstanding M. *Perault's* *Essais Physiques, du Bruit*; and Mr. *Malcolm's* excellent *Treatise of Musick, speculative, practical, and historical*.

This Subject requires a close Attention; and, if duly prosecuted, might unravel some of the greatest Mysteries in Nature: and effectively contribute to increase the Power of Man.

See the *Fable of Proserpina, explained*; in the Author's *Sapientia Veterum*.

a stupefactive and heating Part ; that *Rhubarb* has purging and astringent Parts, &c.

The Enquiry not duly prosecuted, with regard to subtle Differences. 4. But this whole *Enquiry* is weakly and negligently pursued. The more *subtile Differences* of the minute Parts, and the Position of them, in Bodies, are not touched upon. And for the *Motions of the minute Parts* of Bodies, which produce such great Effects, they have not been observed at all ; because invisible, or not subject to the Eye ; but yet they are to be caught by *Experience*. And so the Tumult in the Parts of Solids, when compressed ; which is the *Cause* of all flight in Bodies thro' the Air, and of other mechanical Motions ; is not seen. But if we enquire not attentively and diligently, we shall never discern, much less produce, a great number of *mechanical Motions*.

And the internal Processes of Bodies. 5. Lastly, *Corporeal Motions*, within the Enclosures of Bodies, whereby the Effects pass between the *Spirits* and the *tangible Parts*, as in *Arefaction*, *Colliquation*, *Concoction*, *Maturation*, &c. are not at all touched ; but put off by the Names of *Virtues*, and *Natures*, and *Actions*, and *Passions* ; and such other logical Terms †. See the *Article SPIRITS*.

N I T R E.

Abundance of Nitre on certain Shores. Near the Castle of *Caty*, and by the Wells of *Affan*, in the Country of *Idumæa* ; a great part of the way, one would think the Sea near at hand, tho it be far off. This is caused by the shining of the *Nitre* upon the Seafand ; such abundance of it the Shores there afford †.

N O U R I S H M E N T.

The Nourishment of Animals, before they are brought forth. 'Tis a Work of Providence, that the Yolk of the Egg conduces little to the Generation of the Bird ; but only to its *Nourishment* : for, if a new-hatched Chicken be opened ; much of the Yolk will be found remaining. And 'tis necessary that Birds, which are not formed in the Womb, should have in the Egg, as well Matter of *Nourishment*, as of *Generation*. For after the *Egg* is laid, and severed from the Body of the Hen, it receives no more Nourishment from the Hen ; and only a quickening Heat, when she sits. But Men, and Brutes, need no Matter of Nourishment within themselves ; because they are formed in the Womb of the Female, and nourished continually from her Body †. See the *Article FOODS*.

O.

† The whole of this *Enquiry* still remains strangely neglected, to the great Disadvantage of *Natural Philosophy* ; which seems, almost, a *dead Thing*, for want of it. The Design might, perhaps, be commodiously prosecuted under the Name and Notion of the *Chemistry* of Nature ; so as to treat all the *Natural Operations* according to the Analogy they bear to the artificial ones, within our own Power and Command. The Misfortune is, that few seem well enough acquainted with *Chemistry* to judge of this Analogy, and Conformity : whence many will presently conclude it an *imaginary Scheme*.

‡ There is a curious Paper upon the *Origin of Nitre*, in the *French Memoirs*, An. 1717. that may add great Light to this Particular.

¶ This Article may be referred to Comparative-Anatomy : a Subject that has not yet been duly prosecuted in the philosophical Way ; notwithstanding the Discoveries of *Harvey*, *Higmore*, *Malpighi*, &c. See *Memoires de l'Academie Royale, pour servir à l'Histoire des Animaux*.

O.

ODOURS.

1. **H**eat is requisite to concoct the Matter of sweet *Odours*; and some Moisture to spread the Breath of them. For Woods and Spices are more odoriferous in hot Countries; and Things too much dried, lose their Sweetness: and Flowers, when growing, smell better in the Morning or Evening, than at Noon. Some sweet *Odours* are destroyed by approaching to the Fire; as *Violets*, *Wall-flowers*, *July-flowers*, *Pinks*, and, generally, all Flowers that have cool and delicate *Spirits*. Some continue their *Odour* both over the Fire, and from it; as *Rose-water*, &c. Some *Odours* scarce issue, at least not so pleasantly, without the Fire; as Juniper, sweet Gums, and all *Odours* inclosed in a firm Body. But, generally, those Smells are most grateful, where the degree of Heat is small; or the strength of the *Odour* allay'd: for such things rather court the Sense, than satiate it. And hence, the Smell of *Violets* and *Roses*, exceeds that of Spices and Gums in Sweetness; and the strongest sort of Smells are best in a Vase, at a distance ^{*Sweet Odours of different kinds.*}

2. No *Odour* issues without some Emission of corporeal Substance; contrary to what happens in *Light*, *Colours*, and *Sounds*: for *Odours* spread not to that distance as they do. 'Tis true, some Groves of Oranges, and Heaths of Rosemary, will smell far off at Sea, perhaps twenty Miles; but a Peal of Ordnance will extend as far; tho the Ordnance stand in a little space; whereas these fragrant *Woods* and *Heaths* are of a vast compass. Besides, *Odours* adhere to hard Bodies; as in perfumed Gloves, &c. which shews them corporeal; and thus continue a great while: which Sounds and Light do not. ^{*The corporeal Substance of Odours.*}

3. The Excrements of most Creatures smell ill, chiefly to the Creature that voids them: Pigeons and Horses thrive best, if their *Houses* and *Stables* are kept sweet. The same holds of Cage-birds; and chiefly in those Creatures that feed upon Flesh. Dogs, among Brutes, principally delight in fetid *Odours*; which shews, there is somewhat particular in their sense of Smelling. But Cats are cleanly Creatures; and bury their Excrement. The Cause why Excrements smell ill, is manifest: for, since the Body itself rejects them; much more the *Spirits*: and we find the Excrements of the first Digestion smell the worst; as those of the Belly: but those of the second Digestion better; as the *Urine*: and those of the third, still better; for *Sweat* is not so ill-scented as the other two, especially the Sweat of some Persons, that are full of Heat ^{*The Cause of fetid and fragrant Odours.*}

X 2

4. Like-

Observe all along the physical Foundations for the History of *Odours*. Thus, in the present Case, there is a Foundation laid, for comparing *Odours* with *Sounds*; so far as they are both conveyed by the same Medium of Air.

^w This may be questioned of Light, attended with Flame; but not, so well, where no Flame is; as in the *Glow-worm*, *putrefied Fish*, &c.

^x The Sweat of some Persons is sweet-scented; nearly approaching to that of Musk or Civet. See Mr. Boyle upon *Odours* and *Effluvia*.

Whence Putrefactions are ill-scented.

4. Likewise, most *Putrefactions* yield an odious Scent; being either fetid or mouldy. The *Cause* may be, that *Putrefaction* is a Consistence directly opposite to that of the Body, whilst sound; as being a mere Dissolution of its Form. Besides, the Objects that please any of the Senses, have some Equality, and Order, in their Composition: but where these are wanting, the Object is always ungrateful^y. So a Mixture of many disagreeing Colours, is displeasing to the Eye; Mixture of Discords, displeasing to the Ear; Mixture of many Tastes, displeasing to the Palate; and Ruggedness of Bodies, displeasing to the Touch: but all *Putrefaction*, being a Dissolution of the first Form, is a mere Confusion, and unformed Mixture of the Parts.

Why some Putrefactions are Perfumes.

5. But it seems to cross the former Observation, that some *Putrefactions*, and *Excrements*, yield excellent Odours; as *Civet*, *Musk*, and *Ambergrease*: and the Moss of the Apple-tree, is little better than an Excretion. The *Reason* may be, that there passes in the *Excrements*, and remains in the *Putrefaction*, some fine Spirits; especially from Creatures that are very hot^z. This may be joined with a farther *Cause*, which is more subtle; viz. that the Senses delight not to be over pleased; but to have a Mixture of somewhat, in itself ungrateful. *Discords*, in *Musick*, falling upon *Concords*, make the sweetest Harmony: and strange Tastes delight the Palate; as *Red Herrings*, *Caviar*, *Parmesan*, &c. And, perhaps, the same holds in *Smells*: for the *Odours* above-mentioned, are all strong, and vellicate the Sense. We find also, that the places where Men urinate, have commonly some Smell of Violets; and the Urine, after eating Nutmeg, hath it likewise^a.

Powerful Operations of Effluvia.

6. Apothecaries, upon powdering *Coloquintida*, have been put into a great Scouring, by the bare Effluvia of that Drug. It is a Practice to burn *Guinea-pepper*; which has such a strong Spirit, that it provokes a continual Sneezing in those that are in the Room^b.

The Effects of Fumes, or Vapours.

7. Proper *Fumes* will dry and strengthen the Brain, and stop Rheums and Defluxions; as those of *Rosemary*, *Lignum Aloes*, and *Calamus Aromaticus*, taken in at the Mouth and Nostrils: and, no doubt, there are other Vapours that moisten, refresh, and are proper in burning Fevers, Consumptions, and want of Sleep; such, for instance, as *Rose-water*, *Vinegar*, *Violets*, *Vine-Leaves*, &c. And, in sudden Faintings, to put a Handkerchief, dipped in *Rose-water*, or a little *Vinegar*, to the Nose, collects again the *Spirits*, which were upon the Point to resolve and fall away.

8. The Fume of *Tobacco* comforts the Spirits, and dispels Weariness; partly by opening, but chiefly by its narcotick Virtue; which condenses the Spirits.

^y See the Article MUSICK.

^z See the Article PUTREFACTION.

^a Mr. Boyle seems to have directly prosecuted this Subject, on the Footing here laid down. See his Pieces upon the Mechanical Production of Tastes and Colours, and the Nature, Properties, and Effects of Effluvia.

^b The burning of *Guinea-Pepper*, in a close Room, is said to kill *Engs*: but, if this be tried, 'tis proper the Operator should quit the Room as soon as ever the Pepper is thrown upon the Coals.

^c This is an useful Intimation to Physicians; who might, by this Means, procure Effects in Diseases that they now seem to despair of. See the Processes upon Vegetables, in Boerhaave's Chemistry.

Spirits. It were, therefore, proper to try the Fumes of other things, in the same way of *Smoking*; as well to dry and refresh, as for other Intentions. For a drying Fume, use *Rosemary* and *Lignum Aloes*: try also Nutmeg, *Indian Leaf*^d, &c. 'Tis usual, in Fits of the Mother, to burn Feathers, and other Matters of a disagreeable Odour, with good effect.

9. To follow the Plough has been approved, for refreshing the Spirits, and procuring Appetite: but to do it in the Ploughing for Wheat or Rye, is not so good; because the Earth has spent its sweet Breath in Vegetation, during the Summer. 'Tis, therefore, better to do it when they sow Barly. But because Ploughing is confined to Seasons, 'tis best to take the Air of the Earth, new turned up; by digging with the Spade, or standing by the Digger. Ladies may promote their Health, by kneeling upon a Cushion and Weeding. And both these may be practised in the best Season, which is the early *Spring*, before the Earth puts forth: and the sweetest Earth should be chose for the Purpose. It should be done when the Dew is a little gone off the Ground; lest the Vapours prove too moist. I knew a great Man, who was long lived, and had a Clod of Earth brought him every Morning, as he sat in Bed; where he would hold his Head over it a good while.

The Fumes of the Earth recommended.

10. They use, in Medicine, Pomanders, and Knots of Powders, for drying up Rheums, comforting the Heart, provoking Sleep, &c. For tho these things are not so strong as Fumes, yet they may be held continually in the Hand: whereas *Fumes* can be used but at certain times. Besides, many things breathe better of themselves, than when they come to the Fire; as *Nigella Romana*, the Seed of *Melanthium*, *Amomum*, &c.

The Odours of Pomanders, sweet-Bags, &c.

11. There are two things which internally cool and condense the Spirits; and I recommend the same to be tried externally in Vapour. The one is *Nitre*^e; which I would have dissolved in *Malmsey*, or *Greek Wine*, and the Smell of the Wine received; or, to make it more forcible, pour some of it upon a heated Fire-shovel, as they do *Rose-water* and *Vinegar*. The other is the distilled *Water of Wild-poppy*, which may be mixed in equal Parts with *Rose-water*; and so received, with the Addition of a few Cloves, in a Perfuming-pans. The like might be done with the distilled *Water of Saffron-flowers*.

Vapours for cooling and condensing the Spirits.

12. The Scent of *Musk*, *Amber*, and *Civet*, are thought to promote *Vener*y; which they may do by refreshing and calling forth of the Spirits. Incense, and nidorous Smells; such as those of Sacrifices, were thought to intoxicate the Brain, and dispose Men to *Devotion*; which they may do, partly by a kind of Sadness, or Contristation of the Spirits; and partly by heating and exalting them. Among the *Jews*, the principal *Perfume* of the *Sanctuary* was forbid all common Uses. There are some *Perfumes* prescribed by Writers of *Natural Magick*, which procure pleasant Dreams; and others, they say, that procure *prophetic* Dreams; as the Seeds of *Flax*, *Elewort*, &c.

The Effects of high Perfumes.

Perfumes procuring Dreams.

13.

^d Could not an agreeable Fume be contrived, better suited to the Cure of certain Distempers, than the common Tobacco?

^e See more upon the Subject of Nitre, in the Author's *History of Life and Death*.

^f I do not know that these Things have been tried.

That Odours
may nourish.

13. 'Tis certain, that *Odours* nourish, in a small degree; especially the Odour of *Wine*: and we see Men in Hunger, delight to smell hot Bread. 'Tis reported of *Democritus*, that when he was near dying, he heard a Woman of the Family complain, she should be kept from a Feast she greatly desired to see, on account that there would then be a dead *Corps* in the House. The Philosopher, therefore, caused new Loaves to be sent for; which he opened, poured a little Wine into them; and so kept himself alive with their Scent, till the Feast was over. I knew a Gentleman, who would sometimes fast entirely for three, four, or five Days; but then he used to have, continually, a great Bundle of Herbs, that he smelled to; and, amongst them, some esculent ones, of a strong Scent; as *Onions*, *Garlick*, *Leeks*, and the like ^ε.

The Effects of
Air and O-
dours, with
regard to
Health.

14. There are certain Airs, which Physicians advise their Patients to, in certain Diseases, and upon recovering from long Illnesses; viz. where the Country is open, and not overgrown with Heath, &c. or else, near Forests, and the like. 'Tis noted also, that Groves of Bays cure a pestilential Disposition in the Air; which was accounted a great Cause of the wholesome Air of *Antioch*. Some Soils also, yield odoriferous Herbs spontaneously; as wild Thyme, wild Marjoram, &c. where Briar-roses smell almost like Musk-roses: and these are Signs of an excellent Air. Men should endeavour to have healthful Air in their Houses; which they never can have if the Rooms be low roofed, or full of Windows and Doors; for the one makes the Air close, and stagnant; and the other makes it exceedingly unequal: which is a great Enemy to Health. The Windows, also, should not be high up to the Roof; which is only for Beauty; but low. Stone Walls, also, are unwholesome: but Timber is more wholesome; and especially Brick. It has been practised, with good Success, to make the Walls thick; and to throw a Layer of Chalk between the Bricks, to prevent Dampness.

Odours, why
sweetest at a
Distance.

15. *Odours* are sweeter at some Distance in the Air, than near the Nose; because of the finer Mixture, or Incorporation of the Smell: as Sounds are sweetest, when we cannot hear every part, by itself. Another Reason is, because all sweet Smells have some earthy or crude Odour joined along with them: whence the Sweetness, which is the more spiritual, is perceived at some distance; whilst the earthy part reaches not so far.

Why strongest
in dry Bodies.

16. *Sweet Smells* are most forcible in dry Substances, when broken; so in Oranges and Lemons, the nipping of the Rind, sends out their Odour powerfully: and, generally, when Bodies are moved, or stirred, tho not broken, they smell the more; because there is a greater Emission of the Spirit, when way is made. But a second Cause is, the Impulse of the Air, that brings the Scent faster upon us. The finest Smells, among *Flowers*, are of that kind where the Leaf is not sweet; as in *Violets*, *Roses*, *Wall-flowers*, *July-flowers*, *Pinks*, *Wood-bines*, *Vine-flowers*, *Apple-blooms*, *Bean-blooms*, &c. For where there is Heat and Strength enough in the Plant to make the Leaves odoriferous, the Smell of the Flower is rather weaker, than that of the Leaves; as
in

^ε Is there not something of considerable Use, both to Physicians and others, delivered in this Paragraph?

in *Rosemary-flowers*, *Lavender-flowers*, &c. But where there is less Heat, the Spirit of the Plant is digested, refined, and severed from the grosser Juice, in the Efflorescence, and not before. But Flowers pressed or beat, lose the Freshness and Sweetness of their Odour: for when crushed, the grosser and more earthy Spirit comes out with the finer, and troubles it; whereas, in stronger Odours there are no such degrees of the Issue of the Smell.

17. The Nature of *Orris-root* is almost singular; for there are few *odoriferous Roots*: and in those that are any thing sweet, 'tis only the same Sweetness with the Wood or Leaf: but *Orris* is not sweet in the Leaf; neither is the Flower so sweet as the Root; which seems to have a delicate and tender Heat; that vanishes upon coming above Ground, and feeling the Sun and Air; being a great Mollifier, and smelling like a Violet^b.

Orris, sweet chiefly in its Root.

P.

PAINTING THE BODY.

THE *Turks* have a black Powder, made of a Mineral called *Alcobole*; which, with a fine Pencil, they lay under their Eye-lids, so as to colour them black; whereby the *White of the Eye* is set off whiter. With the same Powder they colour, also, the Hairs of their *Eye-lids*, and *Eye-brows*, which they draw into Arches. And *Xenophon* relates, that the *Medes* used to paint their Eyes. The *Turks*, with the same Tincture, black the Hair of their Heads and Beards. And many with us, who are grown grey, and yet would appear young, make their Hair black, by combing it with a *Leaden-comb*; or the like^c. The *Chinese*, who are olive-coloured, paint their Cheeks Scarlet; especially the *Emperor* and *Grandees*. Generally, barbarous People, that go naked, not only paint themselves, but pounce and raise their Skin, so that the Painting cannot be taken out; and make it into Works^k. So do the *West-Indians*; and so did the ancient *Picts* and *Britons*: whence it seems, that Men would have the Colour of Birds Feathers, if they could; or, at least, gay Skins, instead of gay Clothes.

The Custom of painting the Body, in different Nations.

P A S S I O N S.

1. The *Passions of the Mind*, make the following *Impressions* upon the Body. Fear causes, (1.) *Paleness*; (2.) *Trembling*; (3.) *Erection of the Hair*; (4.) *Starting*; and, (5.) *Sbrieking*. 1. The *Paleness* proceeds hence, that the Blood runs towards the Centre, to succour the Heart: 2. the *Trembling* hence, that

The Impressions made by the Passions of the Mind, upon the Body, in Fear.

^a This Subject of Odours in Plants, is prosecuted in *Boerhaave's Chemistry*, upon the Foundation here laid down. See the *Processus upon Vegetables*. See also, the Article *INFUSION*, above; and Mr. *Boyle's Philosophical Works*.

ⁱ But a much better Way for this Purpose, is to use the common *Solution of Silver*, well diluted with Water: which appears to be the Preparation, sold in *London*, for turning red, or other coloured Hair, to a beautiful brown or black.

^k This is frequently practised, by pricking Holes in the Skin with a Needle, and rubbing pulverized Gunpowder upon the Part.

that by the flight of the Spirits inwards, the external Parts are deserted and forsaken. 3. *Erection of the Hair*, is caused by the closing of the Pores of the Skin; whence the Hair, that before lay aslope, must needs rise. 4. *Starting* is both an Apprehension of the Thing feared; and an Enquiry, in the Beginning, what the Matter should be; whence it is both a Motion of *Sbrinking*, and a Motion of *Erection*: therefore, when a Man would listen suddenly to any thing, he starts; for the *Starting* is an *Erection of the Spirits*, to attend. 5. *Sbricking* is an appetite of expelling that which suddenly strikes the Spirits; for many Motions, tho unable to expel what is hurtful, are yet Offers of Nature, and cause Motions by consent; as in Groaning, or crying out, upon Pain ^k.

Grief.

2. *Grief*, and *Pain*, cause (1.) *Sighing*; (2.) *Sobbing*; (3.) *Groaning*; (4.) *Screaming*; (5.) *Roaring*; (6.) *Tears*; (7.) *Distortion of the Face*; (8.) *Grinding of the Teeth*; and, (9.) *Sweating*. 1. *Sighing* is caused by drawing in a greater Quantity of Breath, to refresh the Heart that labours; like taking a large Draught when one is thirsty. 2. *Sobbing* is the same thing, but stronger. 3, 4, 5. *Groaning*, *Screaming*, and *Roaring*, are caused by an *Appetite of Expulsion*: for when the *Spirits* cannot expel the offending Subject in striving to do it by Motion of Consent; they expel the Voice: and this happens when the *Spirits* yield, and cease to resist; for, if we constantly resisted Pain, we should not groan. 6. *Tears* are caused by a Contraction of the *Spirits* of the Brain, constringing the Moisture thereof; whence *Tears* are sent into the Eyes: and this Contraction, or Compression, causes also wringing of the Hands; for wringing is a Gesture of expressing Moisture. 7. The *Distortion of the Face* is caused by a Struggle; first, to bear and resist, and then to expel; which makes the Parts first knit, and afterwards open. 8. *Grinding of the Teeth*, is likewise caused by collecting the *Spirits* to resist; which makes the Teeth, also, set hard one against another. 9. *Sweating* also, is a compound Motion, from the labour of the *Spirits*; first to resist, and then to expel.

Joy.

3. *Joy* causes, (1.) a Chearfulness and Vigour in the Eyes; (2.) Singing, Leaping, Dancing, and sometimes Tears. All these are the Effects of the Dilatation and Eruption of the *Spirits* into the external Parts; which makes them more lively and brisk. *Excessive sudden Joy* has caused present Death; while the *Spirits* diffused themselves so much, they could not retreat again. *Tears* are the Effects of compressing the lachrymal Glands, upon the Dilatation of the *Spirits*: for Compression of the *Spirits* causes an Expression of the Moisture of the Eyes by consent, as in Grief: but, in Joy, it works by propelling the Moisture, when the *Spirits* dilate, and occupy more room^l.

Anger.

4. *Anger* causes, (1.) *Paleness* in some; and the going and coming of the Colour in others: also, (2.) *Trembling*; (3.) *Swelling*; (4.) *Foaming at the Mouth*; (5.) *Stamping with the Feet*, and bending of the Fist. 1. *Paleness*,
and

^k 'Tis worth observing, how close and strong the Foundations are here laid, for a *Philosophical History of the Passions*.

^l See Boerhaave's *Institutiones Medicae*, pag. 278. *De Voce, Loquela, Cantu, Rifu, &c.*

and the *going and coming of the Colour*, are caused by the heat of the Spirits about the Heart ; which, to refresh themselves, call in more Spirits from the outward parts. And, if the *Paleness* be alone, without sending forth the *Colour* again, it is commonly joined with some *Fear* : but, in many, there is no *Paleness* at all ; only a *Redness* about the Cheeks ; which arises from sending forth the Spirits in an Appetite of Revenge. 2. *Trembling*, in *Anger*, proceeds likewise from a calling in of the Spirits ; and happens, commonly, when *Anger* is joined with *Fear*. 3. *Swelling* proceeds from a Dilatation of the Spirits by over-heating ; and from a Liquifaction, or boiling of the Humours thereupon. 4. *Foaming at the Mouth* proceeds from the same Cause ; being an Ebullition. And, 5. *Stamping*, and *clenching of the Fist*, proceeds from an Imagination of the *Act of Revenge*.

5. Light *Displeasure*, or *Dislike*, causes, (1.) shaking of the Head ; (2.) Frowning, and Knitting of the Brows. These Effects arise from the same Causes as Trembling and Horror ; viz. the retiring of the Spirits ; but in a less degree. For, 1. the *Shaking of the Head* is but a slow and definite Trembling ; and a Gesture of slight Refusal : we see also, that Dislike often causes that Gesture of the Hand we use upon refusing a thing, or warning it away. 2. The *Frowning and Knitting of the Brows*, is a gathering of the Spirits, to resist in some measure : and *Knitting of the Brows* follows upon earnest thought of any thing, tho it be without Dislike.

6. *Shame* causes (1.) *Blushing* ; and, (2.) a *down-cast Look*. *Blushing* is the Resort of Blood to the Face ; which, in the Passion of Shame, is the Part that labours most. And, tho *Blushing* will appear in the whole Breast, if naked, yet it is but in passage to the Face. The *Down-cast of the Eyes* proceeds from the Reverence a Man bears to others ; so that, when he is ashamed, he cannot endure to look stedfastly upon them : and both *Blushing* and the *Casting-down of the Eyes*, are greater when we appear before a number ; and, likewise, when we come before great or reverend Persons ^m.

7. *Pity* sometimes causes, (1.) Tears ; and, (2.) a Side-cast of the Eye. *Tears* here come from the same Cause they do in Grief : for *Pity* is but Grief in another's Behalf. The Side-cast of the Eye, is a Gesture of Aversion ; or an Unwillingness to behold the Object of Pity.

8. *Wonder* causes, (1.) Astonishment, or an immoveable Posture of the Body ; (2.) casting up of the Eyes, and lifting up of the Hands. *Astonishment* is caused by fixing the Mind upon one Object of Thought ; whence it does not expatiate as usual : for, in *Wonder*, the Spirits fly not, as in Fear ; but only settle, and become less apt to move. *Casting up of the Eyes*, and *lifting up of the Hands*, is a kind of Appeal to the Deity ; or the Author, by his Power and Providence, of great Wonders.

9. *Laughing* causes a Dilatation of the Mouth and Lips ; a continued Expulsion of the Breath, with a loud Noise ; which makes the Interjection of Laughter ; and, if violent and continued, Shaking of the Breast and Sides ; and running of the Eyes with Water. Laughing can scarce properly be called a

V O L. III.

Y

Passion ;

^m Ore Pompeii quid mollius ? Nunquam enim non coram pluribus erubuit.

Passion; as having its Source from the *Intellect*: for, in Laughing, there always preceeds a Conceit of somewhat ridiculous: and therefore is proper to Man. The *Cause of Laughing* is but a light Touch of the Spirits; and not so deep an Impression as in other *Passions*: whence it may be excited, and that in great Violence, barely, by tickling some Parts of the Body: and Men, even in a grieved state of Mind, cannot, sometimes, forbear Laughing. It is always joined with some degree of Delight: and therefore has an Affinity with Joy; tho' it be a much lighter Motion^a. Its *Objects* are Deformity, Absurdity, a witty Turn, or the like.

10. As to the *Causes* of the Effects before-mentioned; viz. the *Dilatation of the Mouth and Lips*; the *continued Expulsion of the Breath and Voice*; and the *Shaking of the Breast and Sides*; they all proceed from the sudden Dilatation of the Spirits. *Suddenness* has here a great Share: for any shrewd Turn that lights upon another; or any Deformity, &c. moves Laughter in an *Instant*; which, after a little time, it does not: thus, we cannot laugh at a stale Jest; but only while 'tis new. And, even in *Tickling*, if you tickle the Sides, and give Warning; or give a hard or continued Touch; it does not move *Laughter* so much.

Lust.

11. *Lust* occasions a *Flagrancy in the Eyes*, and a *Priapism*. The *Cause* is, that in *Lust*, the *Sight* and the *Touch* are the Things desired; and therefore the Spirits resort to those Parts which are most affected. And note, in general, that the Spirits, in all Passions, resort most to the Parts that labour most, or are most affected; as, in the last mentioned, they resort to the Eyes and Parts of Generation: in *Fear* and *Anger*, to the Heart: in *Shame*, to the Face: and, in slight *Dislikes*, to the Head^o.

P E N E T R A T I O N.

The restless
Nature of
Things, and
their Desire to
change, and
enter into one
another.

The *Emptiness* of several Bodies, and their Appetite to take in others, is a deep Consideration. *Air* takes in Light, Sounds, Smells, and Vapours, with a kind of Thirst; as not satisfied with its own Consistence: else it would never receive them so suddenly, and easily. *Water*, and all Liquors take up dry and terrestrial Bodies; and dry Bodies drink in Waters, and Liquors: that one is a *Glue* to the other. *Parchments*, *Skins*, *Cloth*, &c. drink in Liquors; tho' themselves are entire Bodies, and not comminuted, as Sand and Ashes are; nor, apparently, porous. *Metals* themselves, readily receive the *Aquæ fortes*; and the *Aquæ fortes* readily penetrate into *Metals* and *Stones*. That *Menstruum* will touch Gold, which will not touch Silver; and *vice versa*. Nay Gold, which seems to be the closest and most solid Body in Nature, greedily drinks in *Quicksilver*. And it seems that this *Reception of other Bodies is not violent*: for 'tis often *reciprocal*; and as it were, with consent. Of the CAUSE hereof, and to what AXIOM it may be referred, consider

^a *Res severa est verum Gaudium.*

^o The Author has many things relating to the *History of the Passions*, in his *Sapientia Veterum*, and *Moral Essays*. See also, the *De Augment. Scientiar* Sect. 11. or the *Fable of Bacchus*. And again Sect. XX and XXI. of *Ethicks*, &c. Consult likewise Mr. *Hutchinson's* late *Discourse of the Passions*.

sider attentively ^a. For the quaint Assertion, that *Matter, like a common Strumpet, covets all Forms*, is but a roving Notion. Flame alone, takes in no other Body; but either overcomes or turns other Bodies into it, as by Conquest; or dyes, and goes out itself ^a. See the *Articles*, NATURE, SPIRITS, and SYMPATHY.

PERCOLATION.

1. 'Tis observed in some Parts of *Africa*, that after a time, the Water in Pits, dug on the Sea-Shore, will grow brackish again. For at length the very Sand, thro' which the Salt-water passes, becomes saline; and so the Strainer itself is infected. The Remedy therefore is, to dig new Pits when the old grow brackish; and thus change the Strainer.

The return of Salineſs in Pits upon the Sea-shore.

2. If a Pit be sunk upon the Sea-shore, deeper than the *Low-water Mark*; but with its Mouth somewhat above the *High-water Mark*; as the Tide comes in, the Pit will fill with Water, fresh and potable. This is commonly practised upon the Coast of *Barbary*; where other fresh Water is wanting. The Thing was also put in Practice by *Cæſar*, who when besieged in *Alexandria*, having the Sea-Water turn'd upon the Wells; thus saved his Army in Despair. But *Cæſar* mistook the Cause, in supposing that all Sea-Sands had natural Springs of fresh Water; for the Pit here fills, as the Tide rises.

Experiments for the ſweetning of Sea-Waters by Percolation.

3. *Salt-Water* has been passed thro' Earth, and ten Vessels, one within another; yet without losing its Saltness, so as to become potable: but *Salt-Water*, strained thro' a greater number of Vessels, has become fresh: which Experiment seems to cross that other of Pits, tho' but in part; if it be true, that more Repetitions do the Thing ^c.

Y 2

4. 'Tis

^a The vulgar *Physicks* scarce takes notice of any such Thing as that here mention'd; tho' it may deservedly seem to constitute the very Essence of *Natural Philosophy*; as shewing by what particular Powers, and Principles, all material Things are separated, and held together. Certainly the *Doctrine of Menstruums*, which has hitherto been chiefly confined to a few *Chemical Operations*, should be set free, and extended to all *Natural Bodies*; so as to discover the Laws of their Cohesion, Union, Separation, Mixture, and Conversion; or the whole Process of Nature, in conserving and repairing, and changing the Bodies of the Universe: the physical CAUSES whereof will probably be found to be numerous particular Laws of Attraction and Repulsion; as, for want of more precise and accurate Notions, we are obliged to call them. And if, at length, the whole of this comprehensive Doctrine can be reduced to an AXIOM; might not that AXIOM contain the true, physical, or efficient Cause of the various Forms and Appearances of Bodies? But this is anticipating too much; unless it were to intimate what Discoveries are still behind; and might be rationally expected, if the Author's Method of Enquiry were diligently pursued.

^c This Subject highly deserves a vigorous Prosecution: and by way of opening to the Enquiry, it might be proper to consult the Chapter of *Menstruums* in *Boerhaave's Chemistry*. The *Philosophical Transactions*, the *French Memoirs*, Mr. Boyle, Dr. Hook, and Sir Isaac Newton, afford some Hints to this purpose; especially with regard to the Conversion of Bodies into Light, and Light into Bodies, &c.

^d This Method of Percolation *per ascensum*, thro' so large a Bed of Sand as the Difference betwixt low and high Water Mark, is impracticable at Sea; whence certain Precipitations, and Distillations, have been proposed for sweetening Salt-Water in long Voyages; But these Methods ^a seem

Why Experiments are often fruitless.

4. 'Tis here worth noting, what poor Imitations are made of Nature, in the common Course of Experiments; unless conducted by Judgment, and some good Light of Axioms¹. For *first*, there is a great difference between passing *Water* thro' many small Vessels; and thro' such a space, as between *Low-water*, and *High-water Mark*. *Secondly*, there is a great difference between *Earth*, and *Sand*; for all *Earth* holds a kind of nitrous Salt², from which *Sand* is free. Besides, *Earth* does not strain the *Water* so fine as *Sand*. *Lastly*, in transmitting the *Sea-Water* into Pits, the *Water* rises; but in the Transmission of it thro' Vessels, it falls. Now the saltier part of *Water* goes to the bottom: and, therefore, no wonder if the straining of *Sea-Water* by *Descent*, should not make it fresh. Again, the very dashing of the *Water*, if it comes from the *Sea*, is more proper to strike off the Salt part, than when the *Water* slides of its own Motion³.

The Advantages of Separation by Percolation.

5. *Percolation* seems a good kind of Separation; not only of thick from thin, and gross from fine; but of more subtle Natures. It also varies according to the Body thro' which it is made; thus, thro' *Woollen*, the Liquor leaves its Fatness behind⁴; thro' *Sand*, its Saltness⁵, &c.

Instances in Gums and Gems.

6. The clear *Gum* of Trees, is but a certain Juice of the Tree, finely strained thro' the Wood and Bark. In like manner, *Cornish-Diamonds*, and *Rock-Rubies*, are the fine Exudations of Stone.

The Feathers of Birds.

7. The Feathers of Birds are of more lively Colours, than the Hairs of Beast; for no Beast has any fine Azure, or Carnation Hair. *Aristotle* gives this Reason for it; that Birds are more in the Sun, than Beasts; which is manifestly false: for Cattle are more in the Sun than Birds, that commonly live in covert. The true Cause may be, that the excrementitious Moisture of living Creatures, which makes as well the Feathers in Birds, as the Hair in Beasts, passes in Birds thro' a more delicate Strainer, than in Beasts: for *Feathers* pass thro' *Quills*; and *Hair*, thro' *Skin*.

Clarification an inward Percolation.

8. The clarifying of Liquors by Adhesion, is an inward Percolation⁶, and effected, when some cleaving Body is mixed and agitated with Liquors; whereby the grosser part sticks to that cleaving Body: whence the finer are freed from the grosser. So the Apothecaries clarify their Syrups by whites of Eggs; which gather all the dregs, and grosser parts of the Juices to them: and the Syrup being set on the fire, the Whites themselves harden, and are taken off,

seem deficient in point of commodiousness and practicability. If the Thing be greatly wanted, Men might perhaps do well to have their Eyes upon *artificial Congelation*; and the ways of procuring it any any Time of the Year.

¹ See the *Novum Organum*, Part II. Sect. I.

² Has this Salt been obtained, from all *Earths*, by washing, boiling, and the common Process for Crystallization?

³ These Particulars deserve to be attentively consider'd, to shew their justness, and lead to farther Discoveries, with relation to the *sweetning of Sea-Water*; and other Operations.

⁴ Thus in Distilling from *Malt-Wash*, as they call it, a thick woollen Strainer separates a large quantity of fulsome unctuous Matter, that would otherwise render the Spirit nauseous and fetid.

⁵ As mention'd above, § 2, 3, 4.

⁶ Where the Strainer passes thro' the Body of the Liquor, carrying down the grosser Parts along with it, as in a Net.

off. So *Ippocras* is clarified by mixing it with *Milk*; stirring it about, and then passing it thro' a woollen Bag: the cleaving Nature of the *Milk*, drawing the Powder of the Spices, and grosser Parts of the Liquor to it; so that in the Passage they stick to the woollen Bag.

9. The clarifying of Water, is an Experiment tending to Health; besides *Water clarified* the Pleasure of the Eye, when Water appears Crystalline. This is effected by placing Pebbles at the Head of the Current; that the Water may strain thro' them ^z.

10. Perhaps, *Percolation* not only causes Clearness and Splendour, but also Sweetness of Odour; for this follows as well as Clearness, when the finer Parts are separated from the grosser. So the Sweat of Men, who have much Heat, much Exercise, clean Bodies, and fine Skins, smells sweet; as was said of *Alexander*: and we commonly find that Gums are odoriferous ^z. See the *Articles*, CLARIFICATION, DRINKS, SALT-WATER, and SEPARATION. *That Percolation may make Bodies odoriferous, as well as clear.*

P I L O S I T Y.

Beasts are more hairy than Men, and Savages more than the civilized: but the *Plumage* of Birds exceeds the *Pilosity* of Beasts. The Cause of greater smoothness in Men is not any great Heat and Moisture, tho' that indeed may occasion *Pilosity*; but there is requisite to *Pilosity*, not direct Heat and Moisture, so much as *excrementitious Heat and Moisture*: for whatever assimilates, goes not into the Hair: and excrementitious Moisture abounds most in Beasts, and Savages. The *Plumage* of Birds has much the same Cause; for Birds assimilate less, and discharge more than Beasts: their Excrements being liquid, and their Flesh generally more dry. Besides, they have no *Organs of Urine*; so that all their excrementitious Moisture goes into the Feathers: whence 'tis no wonder, Birds should commonly be better Meat than Beasts, because their Flesh assimilates finer, and secretes more subtilly. Again, the Head of a Man is hairy at his Birth; which no other Part of the Body is. The Cause may be want of *Perspiration*; for much of the matter of Hair, in other Parts of the Body, goes off by *INSENSIBLE PERSPIRATION*. Besides, the *Skull* being of a more solid Substance, nourishes and assimilates less, and excerns more; so likewise does the *Skin*. We see also, that Hair comes not upon the Palms of the Hands, nor the Soles of the Feet; which are Parts more perspirable: and Children are not hairy; because their Skins are more perspirable ^z. *The Cause of Pilosity and Plumage.*

P L A G U E.

^z 'Tis common in *Italy* and *Holland* to use *filtring Stones*, cut into a kind of Mortars, for clarifying Water; and some have them also in *England*. See the *Article* CLARIFICATION.

^a This Observation might be also extended to *Tastes*: thus *Wines*, &c. taste much finer for being clarified. And whoever shall prosecute this Enquiry of *Percolation*, in a variety of Subjects, may doubtless discover many considerable Things with regard to Refinements. Thus in particular, the Refinement of *Borax*, which has proved a very gainful Business to some, depends upon a proper *Percolation*. So does the refining of *Sugar*, *Manna*, *Tartar*, and numerous *Drugs*.

^b This Article has relation to a *Physical Anatomy*, which seems scarce hitherto begun; I mean the Investigation of the *physical Causes of the Phenomena of Animal Bodies*. For the Causes hitherto assigned in *Anatomy* are rather *Final* than *Physical*; and have a greater regard

P L A G U E.

Prognosticks
of the Plague
from Vermin.

1. During the late Plague, there were found in several Ditches, and low Grounds about *London*, many Toads, that had Tails, two or three Inches long; whereas Toads usually have no Tails at all. This shew'd a great disposition in the Soil and Air, to Putrefaction. 'Tis reported likewise, that *Roots*, as *Carrots* and *Parships*, are more sweet and luscious in infectious Years than ordinary.

Insects, &c.

2. Those Years have been noted for pestilential, and unwholesome, wherein there were great Numbers of *Frogs*, *Flies*, *Locusts*, &c. For these Creatures being engender'd of Putrefaction; an abundance of them shew a general Disposition of the Year, and Constitution of the Air, to Diseases, that proceed from *Putrefaction*^d.

How Odours
affect in the
Plague.

3. The *Plague* is often said to be caught without any manifest Indication; and they report, where 'tis found, that it has the scent of a mellow *Apple*, or of *May-Flowers*. 'Tis also received, that the smell of Flowers, ripe and luscious, are bad in the Plague; such as white *Lillies*, *Cowslips*, and *Hyacinths*.

Antidotes pre-
ventive of the
Plague.

4. The *Plague* is not easily received by those that continually attend the Sick; as Physicians, &c. nor by such as take Antidotes; viz. *Mithri-date*, *Juniper-berries*, *Rue*; or hold in the Mouth, *Angelica*, *Zeodary*, &c. or use *Tar*, *Galbanum*, and the like, in Perfumes; nor again by old People, and such as are of a dry and cold Complexion. On the other hand; the *Plague* soonest seizes those that come out of the fresh Air; those that are fasting; and Children. 'Tis likewise noted to go in a Blood, more than from Stranger to Stranger.

P O I S O N S.

The Infection
of Prisons.

1. The most pernicious *Infection*, next the *Plague*, is that of a Jail; where Prisoners have been long kept close, and unwholesome. Of this we have had Experience, twice or thrice, in my time; when the Judges, and many of the Attendants, sicken'd upon it, and died. It were therefore prudent in such Cases to air the Prison, before the Prisoners are brought out.

How to be imi-
tated.

2. If such destructive Smells may be made by Art, they must, probably, consist chiefly of *Man's Flesh*, or *putrefied Sweat*^f; for those ill Odours which

to the remote *Wisdom*, and *Contrivance*, shewn in the Structure of the Parts, than the direct, and immediate manner of their Formation; or the true Process and Operation of Nature used therein.

^c The same has been said of Fruits, as *Cherries*, &c. and it is usual in infectious Seasons, for the Multitude to accuse some one Thing or other; but with what justness is not so certain.

^d Does the *Plague* proceed from direct *Putrefaction*; or some more latent Cause? To determine this, so as to from *Axioms*, and sure Rules of Practice, requires a rigid Enquiry; which seems hitherto scarce attempted. For they are generally but *crude Observations*, *jejune Experiments*, and *superficial Notions*, that have been published upon this Subject.

^e These Particulars seem remarkably confirm'd by *Diemerbroeck's* Account of the *Plague* at *Nimwegen*. See also *Mr. Boyle's Treatise of Effluvia*; and the *Articles AIR and POISONS*.

^f What certainty is there in these Conjectures? It is indeed said to this Day, that the most destructive Poisons of the *Indians* are prepared from *Man's Flesh*; which, to have any such

which the Nostrils immediately abhor and expel, are not the most pernicious ; but such as have some similitude with the Body ; so that they imperceptibly insinuate themselves, and betray the Spirits.

3. There may be great danger in using such *Compositions* at large Meetings of People, within Doors ; as in Churches, at Arraignments, at Plays, Solemnities, and the like : for poisoning of Air is no less dangerous, than poisoning of Water ; which was practised by the *Turks* in the Wars ; and by *Emmanuel Comnenus* upon the Christians, when they pass'd thro' his Country to the *Holy Land*. And this *poisoning of Air* is the more dangerous in Concourses of People, because their Breath promotes the Reception of the Infection ; and therefore when any such thing is suspected, those publick Places should be perfum'd before the Assemblies meet.

4. The *poisoning* of particular Persons by Odours, has been practised in perfum'd Gloves, or the like : and probably they mix the *Poison* with some sweet Smells, which also make it the sooner received. *Plagues* too have been raised by anointing the Chinks of Doors, and the like ; not so much from the Touch, as because 'tis common for Men, when they find any thing wet upon their Fingers, to put them to their Nose : which one should therefore beware of. The best of it is, that these *Compositions* for infecting the Air, cannot be made without danger of Death to the Makers : But then, they may have Antidotes to preserve themselves ; so that Men ought not to be too secure.

5. The *French report*, that at the Siege of *Naples*, there were certain wicked Merchants, who barrell'd up Man's Flesh, and sold it for *Tunny* ; which proved the Cause of the *Venercal Disease* ^a. And it is certain, that the *Canibals* in the *West Indies*, eat Man's Flesh ; and the *West Indies*, when first discover'd, were over-run with this Distemper : and the most mortal *Poisons*, practised by them, have some mixture of the Blood, or Fat, or Flesh of Man ⁱ.

6. Great *Plagues* have arisen, in several Countries, from the Putrefaction of great swarms of dead Grasshoppers and Locusts, thrown in Heaps. And *Damps* frequently happen in *Mines* ; which kill either by Suffocation, or the poisonous Nature of the Mineral : and those who deal in *refining*, or other Works about Metals and Minerals, have their Brain hurt and stupefied, by the metallic Vapours. And 'tis observable, that *Quicksilver* flies to the Skull, Teeth, or Bones ; insomuch, that *Gilders* usually hold a piece of Gold in their Mouths, to attract the *Quicksilver* : and this Gold they afterwards find

to

Effect, must probably be putrefied ; and used in the height of the Putrefaction. We know that putrefied eggs, and animal Juices, have a poisonous Quality ; and might, perhaps, prove mortal, barely by the Smell. See the *Processes upon Animals*, in *Boerhaave's Chemistry*. See also below, § 5.

^a I suppose this is meant of anointing them with the matter of the Plague-Sores, or other corrupt and excrementitious Parts of a Body infected.

^b The true Cause of this Distemper seems still uncertain ; after all the Enquiry that has been made after it. The principal Reason of the uncertainty seems to be, that every Enquirer carries his own *Idol*, or some preconceived Notion, along with him ; to which he wrests all the Facts and Phenomena.

ⁱ See the Note upon § 2. above.

to be whiten'd. There are also certain Lakes and Pits, as that of *Avernus*, which poison the Birds that fly over them ; or Men that stay too long near them.

*The vapour of
burning of
Coals poison-
ous.*

7. The Vapour of Char-coal, or Sea-coal, in a close Room, has kill'd many : and is the more dangerous, because unattended with any ill Smell, but steals on by degrees ; inducing only a Faintness. When the *Dutchmen* winter'd in *Nova Zembla*, and could gather no more Sticks, they made a Fire of some Sea-Coal they had ; wherewith at first they were much refresh'd : but soon after, there grew a general Silence, and Indisposition to speak, among them ; when immediately one of the Company fainted ; whereupon suspecting what it was, they open'd their Door to let in the Air : and thus saved themselves. The effect seems wrought by the Inspissation of the Air ; and so of the Breath and Spirits. The like happens in Rooms, newly plaister'd, if a Fire be made in them ; by which means the Emperor *Jovinianus* lost his Life ^k.

P O S T U R E S .

*The best Pos-
tures of the
Body for pro-
longing Life.*

1. Lying, not upright, but hollow, from the make of the Bed ; or with the Legs gather'd up, from the Posture of the Body, is the more wholesome ; because thus the Stomach is better assisted ; as being less pensile : and we see, that in weak Stomachs, 'tis useful to lay the Legs high, and the Knees almost to the Mouth. So Galley-slaves, notwithstanding their Misery otherwise, are commonly fat and fleshy ; because the Stomach is somewhat supported in sitting : but is pensile in standing or going. Therefore to prolong Life, 'tis proper to chuse those Exercises wherein the Limbs move more than the Stomach and Belly ; as in rowing ^l, &c.

2. *Megrims* and *Giddiness* happen rather upon rising after long sitting, than while one sits ; because the Vapours, which were gather'd by sitting, fly more into the Head, upon sudden Motion.

3. Leaning long upon any Part makes it numb, and, as we call it, *asleep* : because the Compression of the Part, suffers not the Spirits to have access ; and therefore, as the part comes out of this Numbness, we feel a pricking, which may be caused by the re-entrance of the Spirits ^m.

P R E S E R V A T I O N .

*Bodies prefer-
red in Quick-
silver.*

1. Tie a Stock-gilly-flower gently upon a Stick, and put it into a Glass of Quicksilver ; so that the Flower may be cover'd : then lay a little weight upon the top of the Glass, to keep the Stick down ; and after four or five Days, you shall find the Flower fresh, and the Stalk harder, or less flexible, than it was. By comparing this with another Flower, gather'd at the same time, the Fact will be more manifest. Whence it appears, that Bodies may be excellently preserved in Quicksilver ; and not only preserved, but also indurated

^k This Death is said to have befallen many others ; upon entering Rooms that were kept close whilst the Fire was burning to air them. For Air becomes poisonous by passing thro' Fire ; as is now commonly known, from the *Air-Pump* ; tho the Cause is not satisfactorily discover'd.

^l See the Author's *History of Life and Death*.

^m This Subject may deserve an accurate Enquiry.

indurated by the coldness of the Quicksilver : for tho the freshness of the Flower may be merely owing to *Conservation* ; yet the stiffness of the Stalk, is owing to induration, from the coldness, as it should seem, of the Quick-silver ^a.

2. Earthen Bottles fill'd with different *Liquors*, and well stopped, were hung in a Well of twenty Fathom deep : and some Bottles were let down into the Water ; whilst others were suspended within about a Fathom of its surface. The *Liquors* were *Beer*, *Wine*, and *Milk*. The *Beer* and the *Wine*, as well within the Water as above it, were not palled or deaden'd at all ; but somewhat better than Bottles of the same Liquor kept in a Cellar ; tho such as hung above the Water were apparently the best : and the Beer thus treated flower'd a little ; whereas that under Water did not ; tho it was fresh. The *Milk* soured, and began to putrefy. Yet there is a Village near *Blois*, where, in deep Caves, they thicken *Milk* ; so that it becomes very pleasant : which was one Reason of our Trial, tho it did not succeed. Perhaps the *Milk*, expoted in those Caves is first boiled : it were proper therefore to try it, with *boil'd Milk*, and with *Cream* : for *Milk* is such a compound Body of *Cream*, *Curds* and *Whey*, that it usually turns and dissolves ^b.

The preservation of Liquors in Wells and Vaults.

3. Pluck *Damask-Roses*, and dry them upon a *Lead*, or *Terras*, in the hot Sun ; between the Hours of twelve and two. Then put them into a sweet, dry *Glass*, with a narrow Mouth ; pressing them close together ; but without bruising : stop the *Glass* tight ; and the *Roses* will thus retain, not only their Smell in Perfection, but likewise their Colour fresh ; for a Year, at least. Note, that nothing destroys any Plant, or other Body so much, whether by *Putrefaction* or *Arefaction*, as the adventitious Moisture, that hangs loose in the Body, unless drawn out : for this Moisture carries away the radical *Moisture*, when itself goes off ^c. Whence also in living Creatures, moderate Sweat preserves the Juices of the Body ^d. Note, that the *Roses*, when fully dried, as abovementioned, have little or no Smell ; so that their Odour here is a secondary Odour, that issues from the Flower afterwards.

Experiment for the Preservation of Rose-leaves, &c.

4. 'Tis strange, and deserves a careful Observation, how long *Carcasses* may continue uncorrupted, and in their own Dimensions ; as in the *Mummies of Egypt* : which have some of them lasted, as is conceived, three thousand Years. 'Tis true, they take out the Brains, and Entrails, which are the Parts aptest to corrupt : but the Flesh itself is a soft corruptible Substance.

Prevention of Putrefaction, and the Conservation of Bodies.

V O L. III.

Z

stance.

^a This Experiment should by all means be repeated, varied, and extended to other Bodies. See the Article ANNIHILATION,

^b We noted above, under the Article MILK, that the *History of the Dairy* was greatly wanting ; and shall here add, that the Author has given several excellent Hints relating to it ; more, perhaps, than any one would expect, who has so attentively consider'd the Subject, as to see that it enters deep into *Chemistry*, and *Natural Philosophy*.

^c This is an Observation of great importance in *Natural Philosophy* ; and particularly useful to *Chemists*, *Apothecaries*, *Druggists*, *Perfumers*, &c. whence it might deserve to be explained, illustrated, and verified, by a large *Induction*.

^d This also deserves to be explained along with the rest ; and, indeed, the former Observation is so general, as to reach the Bodies of all the three Kingdoms.

stance. It should seem, that *Putrefaction*, which we conceive to be so natural a period of Bodies, *is but an Accident*; and that Matter hastens not so fast to Corruption as is supposed. Whence Bodies included in Amber, Quicksilver, *Balsams, Wax, Honey, Gums*, and perhaps in Conservatories of Snow, &c. are very long preserved.

The Causes of Putrefaction, how to be suspended.

5. If we provide against the three following *Causes of Putrefaction*, Bodies will not corrupt^o: the *first* is, that *the Air be excluded*; for Air undermines the Body, and conspires with its Spirit to dissolve it. The *second* is, that the *adjacent Body be heterogeneous* to that designed to be preserved; for if nothing can be received by the one, nothing can issue from the other: such Bodies are *Quicksilver*, and *Amber*, with regard to *Herbs, Flies, &c.* The *third* is, that the Body to be preserved, be not so gross as to corrupt within itself, tho' no part of it issue into the adjacent Body; and therefore it must be rather thin and small, than bulky^r.

When the Body to be preserved is large.

6. There is also a *fourth* Remedy, if the Body to be preserved is a thing of bulk; as a *Corps, &c.* for then, the inclosing Body must have a Virtue to draw forth, and dry up, the Moisture of the inward one; else the Putrefaction will play within, tho' nothing issue out. *Livy* relates, that there were found at the same time, two Lead-coffins in a Tomb; one that contained the Body of King *Numa*; and the other, his Books of *sacred Rites, Ceremonies*, and the *Discipline of the Pontiffs*: and that in the first Coffin, where the Body had lain four hundred Years, there was nothing to be seen, but a little Cinders about the Sides; whilst, in the other, the Books were found as fresh as if they had been newly written; being of Parchment, and covered over with Wax-candles three or four doubles. By this it should seem, that the *Romans* in *Numa's* Time, were not so good Embalmers as the *Egyptians*; because the Body was utterly consumed. But *Plutarch*, and others, relate that when *Augustus Cæsar* visited the Sepulchre of *Alexander the Great*, in *Alexandria*; he found the Corps to keep its Dimensions: and tho' the Embalming was, doubtless, the best for that Time; yet the Body was so tender, that *Cæsar* touching but the Nose thereof, defaced it. Which makes it appear strange, that the *Egyptian Mummies* should be reported as hard as Stone-pitch: but, probably, the ancient *Egyptian Mummies* were shrouded in many Folds of Linen, besmeared with Gums, in the manner of *Searcloth*; which, it does not appear was practised upon the Body of *Alexander*^a. See the *Article PUTREFACTION*, and the *Preservation of Fruit* under the *Article VEGETABLES*.

P R I N .

^o It cannot well be too often inculcated, that to know the *Causes of Things*, is obtaining *Directions for stopping, or over-ruling them*; as also for employing them as *Agents* in producing *Effects*. See the *Novum Organum*, Part II. Sect. I.

^r This Enquiry is one of the most capital in all Physicks; Putrefaction being the *Medium* of the grand Changes in Material Things; and the Master-key of the principal Operations, both of *Nature* and *Art*. On which account it should be earnestly recommended to all those who are concerned for the Improvement of *Natural Knowledge*, and the Production of *CAPITAL WORKS*.

^a The Art of *Embalming*, whatever it may have been anciently among the *Egyptians*, is far from the degree of Perfection in *Europe*, which, in all Probability, it might arrive at. But as

PRINCIPLES OF CHEMISTRY.

1. There are two great *Families of Things*, called by the Chemists, *sulphureous* and *mercurial*¹, whereof their third *Principle*, *Salt*, is but a Composition². We may otherwise call these Families of Things, *inflammable* and *uninflammable*, or *mature* and *crude*, or *oily* and *watery*. Thus, Brimstone and Quicksilver abound in the subterraneous Regions, as the Fathers of their Tribes; Oil and Water, in the *vegetable* and *animal* Kingdoms; Air and Flame, in the lower pneumatical Regions; and pure Æther and Light, in the celestial Spaces. And these Pairs of Things, tho unlike in the primitive Differences of Matter, yet seem to have many Agreements. *Mercury* and *Sulphur* are the principal Materials of *Metals*: *Water* and *Oil* are the principal Materials of *Vegetables* and *Animals*; and seem to differ but in Maturation or Concoction. In short, these two Tribes of Things seem vastly extensive; so as to occupy and enter the whole material World. 'Tis therefore one of the greatest *Magnalia Naturæ*, to turn *Water* into *Oil*; greater in *Nature*, than to turn *Silver* or *Quicksilver* into *Gold*³.

Observations upon the two chemical Principles, Sulphur and Mercury.

2. There are four kinds of *Instances*, wherein crude and watry Substances turn into such as are fat and oily; viz. First, in the *Mixture of Earth* and *Water*; which, by the help of the Sun, acquire a *nitrous Fatness*, more than either of them has severally; for thus they put forth Plants, which require both oily and aqueous Juices⁴. The *second* is the *Affimilation of Nourishment*, in the *Bodies of Plants and Animals*; for Plants turn the Juices of mere Earth and Water, into much oily Matter⁵. Animals, tho great part of their Fat and Flesh proceed from oily Aliment, yet assimilate also, in some measure, the Water they drink. But these two Ways of converting *Water* into *Oil*, by Mixture and Affimilation, require many Percolations, a long Continuance of a soft Heat, and several Circulations. The *third* is, in the beginning of *Putrefaction*; as in *Water* corrupted, and the Mothers of distilled Waters; both which have a kind of Fatness, or Oil⁶. The *fourth* is, the *Edulcoration of some Metals*, or rendering of them Saccharine; as in *Saccharum Saturni*⁷, &c.

Instances of Water turned into Oil.

Z 2

3. The

its Perfection principally depends upon a just *philosophical Chemistry*, it may require some Ages yet, to advance it to its height: for *philosophical Chemistry* has but of late began to appear in *Europe*. It may be worth enquiring, whether such Improvements could not be made in the vulgar *Art of Tanning*, as might render it capable of preserving dead *Bodies* in great Perfection.

¹ See M. Homberg's *Essays upon the Chemical Principles*, in the *French Memoirs*, passim.

² This is to be understood not of any Separation, but of an *actual Transmutation*; so that the Matter which had the full Form and Properties of *Water* before, has now the full Form and Properties of *Oil*. See the *Articles ALTERATIONS, and TRANSMUTATION*.

³ See Mr. Boyle's *Sceptical Chemist*; and Dr. Woodward's *Experiments upon the Growth of Vegetables*, in the *Philosophical Transactions*.

⁴ But, it may be suspected, that the unctuous Matter is formed in the *Plant*: Experiment must determine this.

⁵ Here lies a considerable Secret. See Boerhaave's *Chemistry*; on the Method of converting *Vegetable* into *Animal* Matters, by Means of *Putrefaction*. Process 77.

⁶ Here is another considerable Secret: for *Saccharum Saturni* yields an *inflammable Spirit* by Distillation.

The Means of
converting
Water into Oil.

3. The Conversion of Water into a more oily Substance, is promoted by *Digestion*; for Oil is little more than Water digested: and this Digestion is principally carried on by Heat; which Heat must be either outward or inward. Again, this Digestion may be forwarded by *Provocation*, or *Excitation*; which is caused by the Admixture of Bodies already oily or digested: for these will somewhat communicate their Nature to the others. *Digestion* also is strongly performed by the direct *Assimilation of crude Bodies, into Bodies digested*; as in *Plants* and *Animals*, whose Nourishment is far more crude than their Bodies: but this Digestion requires, as was before observed, a length of Time, and many Circulations². See the *Articles*, ALTERATIONS and TRANSMUTATION.

PUTREFACTION.

An Enquiry
into the Means
of introducing,
and accelerating
Putrefaction.

1. The introducing and accelerating of *Putrefaction*, is an extensive Subject; for *Corruption* is reciprocal to *Generation*: and these two are as Nature's Limits, or Boundaries; and the Conductors to *Life* and *Death*¹.

The Causes of
Putrefaction.

2. All *Putrefactions* proceed, chiefly, from the internal *Spirits* of the Body; and partly from the *Ambient*, be it Air, Liquor, or any thing else. The latter Cause takes place by two Means; viz. either by the Entrance of the Substance of the surrounding Body into the putrefied Body; or else by the Excitation and Sollicitation of the putrefied Body, and the Parts thereof, by the surrounding Body. As for the received Opinion, that *Putrefaction* proceeds either from Cold, or preternatural Heat, 'tis trifling: for Cold, in Things inanimate, is the greatest Enemy to *Putrefaction*; tho it extinguishes Vivification, which always consists in attenuated Spirits, that congeal and coagulate with Cold. But as for *preternatural Heat*, 'tis so far true, that if the Proportion of adventitious Heat greatly predominate over the natural Heat, and the Spirits of the Body; it tends to Dissolution, or a considerable Alteration: but this is wrought by *Emission*, or *Suppression*, or *Suffocation*, of the *native Spirits*; and also, by the *Discomposure of the tangible Parts*, and other Passages of Nature; and not by a Conflict of Heats.

3. *Put-*

¹ The Author intended a severe Enquiry into the three Chemical Principles, Salt, Sulphur, and Mercury. He has left us the *Introduction* designed for it; which contains little more than what is delivered under the present *Article*. Himself calls it one of the *profoundest Enquiries of Nature*; and brings under it, the Heads of *Conversion*, or the *Transmutations of Bodies*, and the *primary Collections*, or *original Congregations of Matter*; which, like a general Assembly of a State, give Laws to all Bodies. And tho he makes the Principle *Salt* no more than a Combination of *Sulphur* and *Mercury*, held together by a sharp Spirit; yet he thought proper to admit it in his Enquiry: not only on account of its relation to *Sulphur* and *Mercury*; but because of its extreme Utility, as being the common Link of the *sulphureous* and *mercurial Nature*, and the *Rudiment of Life* itself. In this Enquiry, had he prosecuted it, he proposed to have continued the Use of the Expressions, tho he generally rejected the Opinions of the Chemists, as unsound. We may reasonably expect it would have been a grand and serviceable Enquiry: but he left it for Posterity to finish. Mr. Boyle, Sign. Guglielmini, M. Homberg, and Dr. Stahl, have all contributed to it.

² We have here the beginning of a regular Enquiry into *Putrefaction*; with a steady Eye upon the Processes of Nature.

3. *Putrefaction*, therefore, is the *Work of the Spirits of Bodies*; which are ever attempting to get forth, and congregate with the Air, and enjoy the Sun-beams. The Escape, and spreading of the Spirits, which is a degree of Escape, appears in *five* different Operations: (1.) If the Spirits are detained within the Body, and move violently, there follows *Colliquation*, or Melting; as in Metals, &c. (2.) If they move mildly, there ensues *Digestion*, or *Maturation*; as in *Drinks* and *Fruits*. (3.) If the Spirits be not merely detained, but protude a little, and the Motion be confused and inordinate, then follows *Putrefaction*; which always dissolves the consistence of the Body with great Inequality: as we see in putrefied Flesh, rotten Fruits, shining Wood, &c. and also, in the Rust of Metals. (4.) But if that Motion be in a certain Order, there follow Vivification, and Figuration; as in living Creatures, bred from *Putrefaction*; and in perfect Animals. (5.) But if the Spirits issue out of the Body; then follow *Desiccation*, *Induration*, *Consumption*, *Evaporation*, &c.

Five Operations of the Spirits of Bodies, in order to escape.

4. The Means of inducing and accelerating *Putrefaction* are, (1.) by the *Addition of crude or watry Moisture*; as in the Wetting of Flesh, Fruit, Wood, with Water, &c. for, otherwise, unctuous and oily Substances preserve themselves. (2.) By *Invitation*, or *Excitation*; as when a rotten Apple lies close to another that is sound: or when Dang, a Substance already putrefied, is added to other Bodies. This also appears remarkably in *Church-yards*; where the Earth consumes a Corps in much shorter time than other Earth will. (3.) By *Closets*, and *Suppression*; which detains the Spirits in Prison, and thereby irritates them to seek issue; as in *Corn*, and *Clothes*, which grow musty; but are preserved fresh by the open Air: and this appears more evidently in Agues, which generally proceed from *Obstructions*, and the penning up of the Humours, which thereupon putrefy*. (4.) By *Solution of Continuity*: thus, an Apple will rot the sooner for being cut or pierced; so will Wood; and the Flesh of Animals, where they have received any Wound. (5.) By *exhaling or driving back the principal Spirits*, which preserve the Consistence of the Body; so that when their Government is dissolved, every Part returns to its Nature. This appears in Urine and Blood, when they cool; and thereby break: as also in Gangrenes, or Mortifications of the Flesh, either by Opiates or intense Cold. I conceive, also, the same Effect in Pestilences; when the Malignity of the infecting Vapour disturbs the *principal Spirits*, and makes them fly, and leave their Government; whence the Humours, Flesh, and *secondary Spirits*, dissolve and break, as in an Anarchy^a. (6.) By *the entering of a foreign Spirit*, stronger, and

Ten practical Ways of introducing Putrefaction.

* Were it not proper to range and class *Putrefactions* into different kinds, that the Enquiry might proceed with greater clearness and exactness? *Vegetable*, *Animal*, and *Mineral Putrefactions* are very comprehensive Heads, that allow of numerous Subdivisions in this Enquiry. Thus there is one *Putrefaction of Wines*, another of *Vinegars*; one of *Milk*, another of *Blood*; one of *Vitriol*, another of *Nitre*, &c. that may be accounted for many Species of *Putrefaction*.

^a These Expressions, tho' metaphorical, seem aptly, strongly, and scientifically, to express the Nature of the Thing. And till a *philosophical Language* be introduced, perhaps, it is impossible to describe the internal Natures of Things, without some degree of *Metaphor*.

and more eager than the Spirit of the Body; as in the Bite of the Viper. And this is, generally, the Cause that swelling ensues upon all Poisons: which follows, also, when the Spirits of the Body congregate too much; as upon Blows, and Bruises; or when they are pent in too much, as in Swellings upon Cold. And the Spirits proceeding from the Putrefaction of Humours in Agues, &c. tho bred within the Body, yet extinguish and suffocate the natural Spirits and Heat. (7.) By such a weak degree of Heat as sets the Spirits in a small degree of Motion, but is not able either to discharge them, or digest the Parts; as in Flesh kept in a warm Room; which, in a cool Larder would keep longer: and we see that Vivification is effected by such soft Heats as these; for Example, in the hatching of Eggs; the heat of the Womb, &c. (8.) By releasing the Spirits, which before were close confined by the Solidity of their Cover, whereby their Appetite of issuing was checked; as in artificial Rusts, induced by Menstruums, upon Iron, Lead, &c. and hence Wetting hastens Rust or Putrefaction, because it softens the Crust for the Spirit to come forth. (9.) By the Interchanges of Heat and Cold, or wet and dry: as we see in the mouldering of Earth exposed to Frosts and the Sun; and in the more hasty rotting of Wood, that is sometimes wet, and sometimes dry. (10.) By Time, and the Operation, or Process of the Spirits; which cannot keep their Station, especially if left to themselves; and there be no Agitation or local Motion: as we see in Corn not stirred; and Men's Bodies that are not exercised. All Mouldiness is the beginning of Putrefaction; as the Mouldiness of Meats, Oranges, Lemmons, &c. which Mouldiness, afterwards, breeds Worms, or more odious Putrefactions; and therefore, commonly proves of an ill Odour. Or if the Body be liquid, and not apt to putrefy totally, it will cast up a Mother on the top, like the Mother of distilled Waters^b.

Ten Means of
preventing
Putrefaction.

5. 'Tis of great Use, to enquire into the Means of preventing Putrefaction; as therein consist the Means of preserving Bodies: for Bodies have two kinds of Dissolution; the one, by Consumption and Desiccation; the other, by Putrefaction^c.

6. The first Means of prohibiting Putrefaction, is Cold: for we see, that Meat and Drink will last longer unputrefied in Winter, than in Summer; and Flowers and Fruits, put in Conservatories of Snow, keep fresh. This Cause operates by Detention of the Spirits, and Constipation of the tangible Parts.

7. The second Means, is Astringent: for Astringent prevents Dissolution; as we generally see in Medicines; whereof such as are Astringent, resist Putrefaction: and, for the same Reason, a small Quantity of Oil of Vitriol will

^b This Subject of Putrefaction, tho so important in itself, seems to have been greatly neglected by Philosophers. Some few Hints are given us of it by Mr. Boyle, and Sir Isaac Newton; but Dr. Stahl appears to have carefully observed this grand Process of Nature, so as to continue the strict Enquiry here begun by the Author.

^c These larger Observations, as the Author usually calls them, ought to be well attended to, by all who desire to continue his Enquiries.

will long preserve fresh Water from putrefying^d. And this Astringent is found in a Substance that has a virtual Cold; and works, partly, by the same Means as Cold.

8. The *third* is, *Exclusion of the Air*; and again, *exposing to the Air*: for these Contraries work the same Effect; according to the Nature of the Subject-matter. So we see that Beer, or Wine, in Bottles close stopped, lasts long; that the *Garner*s under ground, keep Corn longer than those above; that Fruit closed in Wax, keeps fresh; as likewise Bodies put into Honey, or Flower; and Liquors, Drinks and Juices, with a little Oil on the top: as, on the contrary, Cloth and Apparel, not aired, breed Moths and Mould. The *Cause* of the Difference is, that in Bodies requiring Detention of Spirits, the Exclusion of the Air doth good; as in Drinks, and Corn: but in Bodies that require Emission of the Spirits, to discharge some of the superfluous Moisture, it doth hurt: for these require airing.

9. The *fourth* Means, is *Motion*, and *Stirring*; for Putrefaction requires Rest; its subtile Motion being disturbed by any Agitation: and all local Motion keeps Bodies entire, and their Parts together. Thus, the turning of Corn in a *Garner*, or letting it run like an Hour-glass, from an Upper-room into a lower, keeps it sweet: running Waters do not putrefy: and in the Body, Exercise hinders *Putrefaction*; as, on the contrary, *Rest*, and *want of Motion*, promote it.

10. The *fifth* Means, is the *Breathing forth of adventitious Moisture*, in Bodies: for, as Wetting hastens *Putrefaction*; convenient Drying, whereby only the more radical Moisture is kept in, prevents it: so we see, that Herbs and Flowers, if dried in the Shade, or in the hot Sun, for a short time, keep better: for, without this Drying, the Emission of the loose and adventitious Moisture, betrays the radical Moisture, and carries that out with itself.

11. The *sixth* Means, is *strengthening the Spirits of Bodies*; for as a great Heat keeps Bodies from Putrefaction, but a tepid Heat inclines them to it; so a strong Spirit preserves from, and a weak or faint Spirit disposes to Corruption. Thus, salt Water corrupts not so soon as fresh: and salting of Oysters, and Meat, keeps them from Putrefaction. It should be also tried, whether Chalk does not preserve Water from putrefying, or Drink from speedy souring^e: strong Beer will last longer than small; and all things that are hot, and aromatic, help to preserve Liquors^f, or Powders, &c. which they do as well by strengthening the Spirits, as by soaking out the loose Moisture.

12. The

^d This is proposed by a late Author as a new Discovery; and recommended as an effectual Way of preserving fresh Water at Sea.

^e Infomuch that Corn is said, by a proper Exclusion of Air and Moisture, to have been preserved, under Ground, for forty, fifty, or even a hundred Years.

^f Chalk seems to preserve Water, in some degree; but makes Wine run sooner into Corruption. Those who will try the Experiment, may here find a considerable Secret, with relation to various and acetous Fermentation, and Putrefaction.

^g Here again, is a considerable Secret intimated. Thus, for Instance, how strongly soever the vulgar Notion may run, that Brandy is an Enemy to Wine, as they phrase it, yet the

12. The *seventh Means*, is a *Separation of the cruder Parts*, which renders the Body more equal : for all imperfect Mixtures are apt to putrefy ; and watry Substances are more apt to putrefy than oily ^b. So distilled Waters will last longer than raw Waters ; and things that have passed the Fire, longer than those that have not passed the Fire ; as dried Pears, &c.

13. The *eighth Means*, is drawing forth, continually, that Part where the Putrefaction begins ; which is, commonly, the loose and watry Moisture : not only because it provokes the radical Moisture ^c to come forth with it ; but also because, being detained in the Body, the Putrefaction takes hold of it, and thus infects the rest ; as we see in the embalming of dead Bodies : and the same holds of preserving Herbs, Fruits, or Flowers, in Bran or Meal.

14. The *ninth Means*, is the Commixture of things more oily or sweet ; such being least apt to putrefy, for the Air works little upon them : whence such Bodies, not putrefying themselves, they preserve the rest : thus we see Syrups, and Ointments, last longer than Juices.

15. The *tenth Means*, is the Commixture of somewhat dry ; for Putrefaction begins first from the Spirits, and then from the Moisture ; but dry things are unapt to putrefy : whence Smoke preserves Flesh ; as we see in Bacon, Neats Tongues, &c. The Opinion, that condensed Air preserves Bodies longer than other Air, seems probable ; because condensed Air being over-charged and compressed, will hardly receive, but rather repel the Exhalations of any thing. It was tried in a blown Bladder with Flesh, and a Flower ; but without Success : for dry Bladders will not blow ; and new Bladders rather promote Putrefaction. The Way, therefore, is to blow strongly with a Pair of Bellows, into a Vessel containing what you would have preserved ; and stopping the Orifice at the Instant the Bellows are withdrawn ^k.

R.

R A I N.

Whence the
Scarcity of
Rain in E-
gypt.

IT is strange, that tho the River Nile overflows Egypt, there should be little or no Rain in that Country. The Cause is either in the Nature of the Water, the Nature of the Air, or both. It may be ascribed to the long Course of the Water ; for swift-running Waters evaporate not so much as standing Waters : or to the Concoction of the Water ; for Waters well concocted,

Cooper upon the Spot, knows that most Wines, and even Ports, require to be dosed with Brandy, to fit them for the Market.

^b Here, again, are two larger Observations, almost fitted for Axioms.

^c If any Objection be made to the Word, *essential Moisture* may be used in its stead ; as in Raisins, for instance, their radical, or essential Moisture, is only the Saccharine Juice, and not the aqueous Part, wherewith it is mixed in the Grape.

^k This latter part of the Enquiry has been largely prosecuted by Mr. Boyle. See his *pneumatical Experiments*, passim. But in what we may call the more internal, physical, or chemical Part it seems to have been almost overlooked by the generality of Philosophers, considering the Discoveries it might afford.

concocted, evaporate not so much as crude Waters : and Water upon the Fire, evaporates not so fast after some time boiling, as at first. But the Water of the Nile is sweeter than other Water in taste ; and excellent for the Stone, and hypochondriac Melancholy ; which shews it to be lenifying. It also runs thro' a hot and flat Country, without Shade either of Hills or Woods: whence the Sun must needs have great Power to concoct it. As for the Air ; it may be thin and thirsty ; so as when it receives any Moisture from the Water, to imbibe and dissipate it thro' its whole Body, and not suffer it to remain in Vapour, so as to be the Cause of Rain¹. See the Article AIR.

R A I N B O W .

'Tis observed by the Ancients, that where a Rainbow seems to hang, or touch the Earth, there breathes a sweet Odour. If the Fact be true, the Cause may be, that this happens in certain Matters, having in themselves some Sweetness, which the fine Dew of the Rainbow draws out: for thus soft Showers make the Ground sweet. Perhaps, also, the Water itself of the Rainbow, has some Sweetness ; for the Rainbow consists of a Collection of small Drops, which cannot possibly fall but from the Air that is very low ; and therefore may lodge the Sweetness of the Herbs and Flowers, as a distilled Water: for Rain, and other Dew that falls from on high, cannot preserve the Smell ; which is dissipated in the drawing up. Some Waters also, may have a degree of Fragrance ; tho we find it sensibly in no Pool, River, or Fountain : but clean Earth, newly turned up, hath a Freshness and good Scent ; which Water, if it be not too equal and uniform (for equal Objects never move the Senses) may also have. Bay-salt, which is but a kind of congeal'd Water, will sometimes smell like Violets^m.

*Of Sweetness
of Odour from
the Rainbow.*

R A R E F A C T I O N .

Barly swells but little in boiling ; Wheat more ; and Rice extremely, even to three times its Bulk. The Cause is, that the more close and compact Bodies will dilate the most : but Barly is hollow, Wheat more solid, and Rice the most solid of all. Perhaps, also, some Bodies have a kind of Lentor, and a more communicable Nature than others ; as we see in Coloration: for a small Quantity of Saffron will tinge more than a great one of Brasilⁿ.

*The Cause of
the Swelling,
and Dilatation
of Grain in
boiling.*

V O L . III .

A a

R E -

¹ But small Advances have been yet made towards an inductive Meteorological History : whence most Points relating to it, are little better than conjectural ; except what the Author has in his History of Winds.

^m Consult, upon this Head, the Chapter of Water, in Boerhaave's Chemistry ; and the Processes upon Vegetables, in the same Work.

ⁿ Here is an useful Subject started, that might deserve to be largely prosecuted, in a History of dry or solid Panadas, Grewels, Jellies, Mucilages ; and various other sorts of cheap, parable, and wholesome Aliments, both for the Sick and Sound, as well at Sea as at Land. But the thoughts of such a History seem nauseated by Philosophers ; and, till this Nausea be removed, the Subject must skulk in the Kitchen.

REJUVENESCENCY.

Of casting the Skin and Shell in some Creatures,

The *casting of the Skin* is, by the *Ancients* compared to the *breaking of the Secundine*; but unjustly: for thus every casting of the Skin were a new Birth: besides, the *Secundine* is a general Cover, not shaped to the Parts, as the Skin is. The Creatures that cast the Skin are, the *Snake*, the *Viper*, the *Grasshopper*, the *Lizard*, the *Silk-worm*, &c. Those that cast the Shell are, the *Lobster*, the *Crab*, the *Cray-fish*, the *Dodman*, the *Tortoise*, &c. The old Skins are found; but the old Shells never^o: so that, perhaps, they scale off, and crumble away by degrees. This Renovation is known by the extreme tenderness and softness of the new Shell, joined with the freshness of its Colour. The *Cause of casting the Skin and Shell*, should seem to be, (1.) the great Quantity of Matter in those Creatures, fit to produce them; and, (2.) the Looseness of the Skin, or Shell; that sticks not close to the Flesh: for 'tis the new Skin, or Shell, that thrusts off the old. In Deer, 'tis the young Horn that pushes off the old one; in Birds, the young Feathers displace the old: And Birds that have much Matter for the Beak, cast their Beaks; the new ones thrusting off the oldⁿ.

RIGHT AND LEFT.

Of the Right and Left-side.

The Senses are alike strong, both on the Right and Left-side; but the Limbs on the Right-side, are strongest^a. The *Cause* may be, that the Brain, which is the Instrument of the Sense, is alike on both Sides; whilst the Motion and Hability of Moving, are somewhat forwarded by the Liver; which lies on the Right-side. Perhaps, also, the Senses are exercised indifferently on both Sides, from the Time of Birth; but the Limbs are used most on the Right-side, by *Custom*: for we see some are left-handed; who are such as have used the Left-hand most^r.

S.

S A L A M A N D E R.

How the Salamander may endure the Fire.

There is an ancient Tradition of the *Salamander*, that it lives in, and has the power of extinguishing Fire. If *this be true*, two things are required to the Operation: *first*, a very close Skin, to keep out Flame; which, in the

^o Consult the *French Memoirs*; and *Philosophical Transactions*, upon this Point.

^p These are to be understood as *Instances of Approach*, in the Subject of *Rejuvenescency*; that ought to encourage an Enquiry into the Means of renewing the Body in old Age. But Men seem to shew all the Frigidity, and Despondency of Age, on this Occasion.

^q Except in Left-handed People.

^r May there not be a particular and original Conformation in the Limbs of some Persons, disposing them to use their Left-hand, or Left-leg, more than their Right? for considerable Pains have been taken, to break some Children of the Habit of using the Left-hand; but without Success. It might likewise deserve to be examined, whether the Right-side Limbs of the Body do not naturally grow larger than the Left, in most People; without their using them more: This should be tried in *Ambodexters*, &c. The Right Testicle seems, generally, bigger than the Left.

the midst, is not so hot: for, if the Palm of the Hand be besmeared thick with the White of an Egg, and Spirit of Wine be poured upon it, and set on fire, one may endure the Flame for some time. The *second* thing is an extreme Coldness, and quenching Virtue, in the Body of that Creature; which chokes the Fire. We see that Milk quenches Wild-fire better than Water; because it enters better[†].

S A L T W A T E R.

It has been observed, that *salt Water* boiled, and cooled again, is more potable than when raw; yet the Taste of the Salt does not rise in Vapour: *A Way of making salt Water fresh.* for the distilled Water proves fresh. The *Cause* may be, that the Salt of the Water partly rises in a kind of Scum, and partly falls in Sediment; and so, rather separates than evaporates: a saline Taste being too gross to rise in Vapour, as well as a bitter one; for the simple distilled Waters of Wormwood, and the like bitter Plants, are not bitter[†]. See the *Article PERCOLATION*.

S E A.

1. The Sea is clearer when the North, than when the South-wind blows: *The different Clearness of the Sea.* for *salt Water* has a little Oiliness on its Surface; as appears in very hot Days. And again, a South-wind somewhat warms or relaxes the Water; and no Water when boiling, is so clear as when cold[†].

2. Shallow, narrow Seas break more than deep and large ones: for the Impulse being the same in both; where there is a greater Quantity of Water, and Space enough, the Water rolls and moves more slowly, and with a slower Rise and Fall: but where there is less Water, less Space, and the Wa-

A a 2

ter

[†] These Intimations of the Author receive great Confirmation from the Observations of M. Maupertuis, made upon the *Land Salamander*; and published in the *French Memoirs* for the Year 1727.

[†] The due prosecution of this *Enquiry* requires a Distinction to be observed betwixt *Salt-Water* and *Sea-Water*; otherwise many fruitless Experiments may be made for separating common Salt, dissolved in common Water, that shall by no means come up to the Case of rendering *Sea-Water* sweet and potable. An exact *Analysis of Sea-Water* seems hitherto wanting; to shew its several Ingredients, and their Proportions. Thus it may, upon Examination, be found to contain a bitter unctuous or bituminous Matter, and the putrefied Substance of Fish, &c. as well as a certain Proportion of common Salt; and it must be purified from all these, before it can serve the Purposes of common Water. What Effect will the *Filtring-stone* have, in separating the foul, unctuous, putrefied, and saline Parts of *Sea-Water*? Who has shewn the Methods that seem best adapted for obtaining of this End; whether *Precipitation*, *Sedimentation*, *Percolation*, *Inversion*, *Distillation*, or *Congelation*? There are some Hints to this Purpose in the Writings of Mr. Boyle; the *Philosophical Transactions*; and the *French Memoirs*.

[†] There may be somewhat optical in this case, besides the Causes here assigned: thus, for Instance; a River, or the Sea, will sometimes appear clear and undisturbed on one hand, and muddy, or ruffled on the other; according to the Situation of the Eye: or as some light Breeze catches the Surface of the Water, and ruffles it in a particular Part. But for the Clearness of the Sea, at great Depths, see Dr. Halley's *Account of the Diving-Bell*, in the *Philosophical Transactions*.

ter dashes more against the Bottom, it moves swifter, and more perpendicularly ; for in the breaking of Waves, there is always a Precipice ^u.

S E N S E S.

The Cause of the Pleasures and Displeasures of the Senses.

Harsh Sounds, as that of a Saw when it is filing, make a Shivering or Horror in the Body, and set the Teeth on edge ; for the Objects of the Ear affect the Spirits immediately, either with Pleasure or Offence : but no Colour affects the Eye with great Displeasure. There are, indeed, Sights that are horrible ; because they excite the Memory of things odious : whilst the same things painted, have little effect. But for *Smells, Tastes, and Touches*, they affect by a Participation, or Impulse of the Body of the Object. 'Tis *Sound* alone, that affects most immediately and incorporeally. This is manifest in Musick, with its Concords and Discords ; for all Sounds, whether sharp or flat, if they be sweet, have a Roundness and Equality ; and if harsh, are unequal : for a Discord itself, is but a Harshness of differing concurrent Sounds. 'Tis true, Inequality not dwelt upon, but transient, is rather an Increase of Sweetness ; as in the Purling of a wreathed String ; the Hoarseness of a Trumpet ; and the Nightingal-pipe of a Regal ; and in a Discord falling directly upon a Concord : but dwelt upon, 'tis offensive. Hence there are three degrees of Pleasure and Displeasure, in Sounds ; viz. sweet Sounds, Discords, and harsh Sounds, which are differently named, *Shrieking, Grating, &c.* As for setting the Teeth on edge ; we may plainly observe, what an Intercourse there is between the Teeth and the Organ of Hearing, by taking the End of a Bow in the Teeth, and striking upon the String ^v.

SEPARATION OF BODIES BY GRAVITY.

Intimations of Ways for separating Liquors by Gravity.

1. Put Water into the Belly of a Glass-Egg, and a parcel of Claret and Water, mixed, into another open Glass ; invert the Stem of the Egg into the Wine and Water, stopping the Orifice with the Finger ; then removing the Finger, continue the Glass in the same Posture ; and it will unmix the Wine from the Water : the Wine ascending to the Top of the upper Glass, and the Water descending to the Bottom of the lower ^x. The Operation is apparent to the Eye ; for the Wine will visibly rise, in a small Vein, thro' the Water. To render the Experiment more elegant, and because it requires some small time, the upper Glass may be suspended : but as soon as there is so much pure unmixed Water collected in the Bottom of the lower Glass, that the Mouth of the upper dips into it, the Motion ceases.

2. If

^u See more to this Purpose in the Author's Account of the *Ebbing and Flowing of the Sea* ; in the PHILOSOPHIA PRIMA.

^v See this Subject farther prosecuted under the *Articles* AFFECTIONS, MUSICK, ODOURS, and SOUND.

^x There is some Caution required to make the Experiment succeed ; particularly, the Stem of the Glass-Egg should be slender.

2. If the upper Glafs be charged with Wine, and the lower with Water, there follows no Motion at all: and if the upper Glafs be of pure Water, and the lower of Water coloured, there follows no Motion. But it has been tried, that tho the Mixture of Wine and Water, in the lower Glafs, be three parts Water to one of Wine, it does not slacken the Motion. This Separation of Wine and Water appears to be made by Gravity: for it only succeeds in Bodies of unequal Gravity; and the heavier Body must always be in the upper Glafs: but then observe, that the Water being penfile, and there being a great weight of Water in the Belly of the Glafs, sustained by a small Pillar of Water in the Neck, is the Thing that gives the Motion; for Water and Wine in one Glafs, will hardly separate by long standing.

3. This Experiment should be extended to Mixtures of different Liquors, and to Fluids which consist of several similar Parts: try it therefore with Brine, or salt Water, and fresh Water; placing the salt Water in the upper Glafs, to see whether the fresh will rise. Try it, also, with Water sugared, and pure; to see whether the Water that rises will lose its Sweetness: for which Purposes, it were proper to have a little Stop-cock in the Belly of the upper Glafs.

S H A D O W S .

The Extremities of Shadows always seem to tremble; because the little Motes in the Sun are constantly in motion; tho there be no Wind: and these moving in the Meeting of the Light and Shade, from the Light to the Shade, and from the Shade to the Light, may make the Shadow appear to move, because the Medium moves ^{*The Motion of Shadows.*}

S H E L L - F I S H .

Shell-fish have been compared, and ranked with Insects; but, I know not why: for they have Male and Female, like other Fish; and are not bred of Putrefaction. Indeed Oysters, Cockles, and Muscles, which have no local Motion, have no discriminate Sex. *Quære*, in what time, and how they are bred? It seems, that Shells of Oysters grow where there were none before; and the great Horse-muscle, with the fine Shell, found in Ponds, has bred within thirty Years: but then, they not only open and shut, as Oysters do, but also remove from place to place ^{*The Nature of Shell-fish.*}

S I C K -

¹ This being tried with Red Port-Wine and Water; there was no manifest Separation in a Month's time.

² The Experiments of this kind are attended with Difficulties, and not yet brought to Perfection. See the Essay lately published for Concentrating Wines, and other fermented Liquors, or taking their superfluous Waters out of them to Advantage.

³ See more to this Purpose in Sir Isaac Newton's Opticks.

⁴ Thus, at the Bottom of dry Ponds where Muscles are, 'tis usual to find several long Traces: made by the Motion of the Muscle that lies at the End of each Trace, respectively. There is a curious Paper upon this Subject of Muscles, in the French Memoirs.

SICKNESS.

*Why more are
sick in Sum-
mer, but most
die in Winter.*

1. 'Tis common for more to be sick in Summer, and more to die in the Winter; except in pestilential Diseases, which usually reign in the Summer, or Autumn. The *Reason* seems to be, that Diseases are chiefly *caused* by Heat^c; and chiefly cured by Sweating and Purging: which Operations are more easily excited in Summer. But most die of *pestilential Diseases* in Summer; because these breed most in that Season: otherwise the Constitutions that are touched, run the greatest Danger in Winter.

*Whether Heat
and Moisture
be the Cause of
Pestilences.*

2. 'Tis a general Opinion, that hot and moist Years are most pestilential; and, that Heat and Moisture cause Putrefaction upon the Surface of the Earth. In *England*, this is not true; for there have often been great Plagues in dry Years: perhaps, because Drought, in the Bodies of the Islanders, accustomed to a moist Air, exasperates the Humours, and makes them more apt to putrefy, or inflame: besides, it commonly taints the Waters, and makes them less wholesome. Again, in *Barbary*, Plagues break out in the Summer Months; when the Weather is hot and dry.

*Epidemical
Diseases owing
to a Series of
the Seasons.*

3. Many Diseases rage at particular times: the *Cause* whereof is falsely imputed to the *Constitution of the Air* at that time; being, in reality, owing to a *Series of the Seasons of the Year*: whence *Hippocrates*, in his *Prognosticks*, justly observes the Diseases that ensue upon the Nature of the four precedent Seasons of the Year^d.

S L E E P.

*Creatures that
sleep all Win-
ter.*

1. There are many Creatures that sleep all the Winter; as the Bear, the Hedge-hog, the Bat, the Bee, &c. and they all grow fat by sleeping; and void nothing. The *Cause* of their fattening may be, the Want of Assimilation; for whatever does not assimilate to Flesh, turns either to Sweat, or Fat. These Creatures, for one part of their sleeping Time, have not been observed to stir; and, for the other part, to stir, but not to remove: and they chuse warm, close Places, to sleep in. When the *Dutch* wintered in *Nova Zembla*, the Bears went to sleep about the middle of *November*; and then the Foxes, which durst not appear before, began to come abroad. 'Tis observed, by some, that the She-bear breeds, and lies with her Litter, during this time of Rest: and, that a Bear big with Cub, has been seldom seen.

2. Those

^c This seems to hold of *inflammatory Diseases*; which are, perhaps, by much, the greatest Number.

^d There is Matter of Instruction here laid down, in order to a *Natural History of Diseases*: a thing greatly wanted; if it could be procured without any Mixture of *Hypothesis*, *Fiction*, and *Fancy*, wherewith the Writings of Physicians generally abound. But no great Progress can well be expected in it, without a previous Enquiry into the *Natural Chemistry of the Weather*, and its Effects on the Body, thro' the different Seasons of the Year. See the Author's *History of Winds*.

2. Those that are very cold, especially in their Feet, cannot soon go to sleep. The *Cause* may be, that Sleep requires a free Respiration, which Cold hinders; for in great Colds a Man can scarce draw Breath. Another *Cause* may be, that Cold calls out the Spirits to assist against it: whence they cannot so well come together, and collect in the Head; which is always required in Sleep. And, for the same Reason, Pain and Noise prevent Sleep; which Darkeness promotes.

3. Some Sounds incline to Sleep; as the blowing of the Wind, the trickling of Water, the humming of Bees, soft Singing, Reading, &c. The *Cause* is, that they move in the Spirits, only a soft and gentle Attention; and whatever moves Attention, without too much Labour, stills the natural and discursive Motion of the Spirits.

4. Sleep nourishes, or, at least, preserves Bodies a long time. Beasts that sleep the Winter, grow fat tho they eat nothing. Bats have been found in Ovens, and other hollow, close Places, matted one upon another; whence, 'tis probable, they sleep in the Winter, and eat nothing. *Quære*, whether Bees do not sleep all the Winter; and spare their Honey? Butter-flies, and other Flies, not only sleep, but lie as dead, all Winter; yet revive again, with a little heat of the Sun, or a Fire. A Dormouse will sleep for some Days together, both in Winter and Summer, without eating.

S N E E Z I N G.

Looking against the Sun provokes Sneezing^e; not by heating the Nostrils; but by drawing down the moisture of the Brain: for it will make the Eyes run with Water; and the drawing of Moisture to the Eyes, draws it to the Nostrils, by consent; whence follows Sneezing: as, contrariwise, the tickling of the Nostrils within-side, draws Moisture to the Nostrils, and to the Eyes by consent; for they, also, will water. Yet it has been observed, that if a Person be going to sneeze; the rubbing of the Eyes, till they water, will prevent it: the Humour, which was descending to the Nostrils, being thus diverted to the Eyes.

^e There are many Particulars relating to this *History of Sleep*, to be found in Mr. Boyle's *Philosophical Works*; the *Philosophical Transactions*, &c. But the Subject requires to be farther continued, in the *inductive Method*. See the Author's *History of Life and Death*.

^f This perhaps may have sometimes been tried without Success.

^g The present *Anatomy*, and *Physiology*, scarce reach to these subtile Operations of the Body: nor can we hope to see their *Causes* investigated, without proper Sets of Experiments, which few seem, hitherto, disposed to make. Certainly, a more active and penetrating Philosophy is here required, than the vulgar Philosophers are apprized of; as consisting, not in the gross, but almost infinitely fine Particles of Matter, which too commonly pass for notional things; tho the immediate *Instruments* of all the more subtile Operations. But, perhaps, the Time for these things is not yet.

*A Draught for the particular HISTORY of PHONICKS:
or the Doctrine of SOUND and HEARING.*

I N T R O D U C T I O N.

SOUND is a capital Thing, and a great Secret in Nature ; as having a Virtue that may be call'd incorporeal : whereof there are but few other *Instances*. And besides the more obvious Uses of an *Enquiry* into this Subject, it affords a proper Exercise to the Understanding, by mixing the Contemplation of spiritual Species, and Operations at a distance ; with the Consideration of such Things as operate only by a Communication of Substance to the Touch. Whence the Mind now called off from Matter, may be rectified, and taught to become impartial^a. But certain Observations upon *Sounds*, having given Birth to the *Art of Musick*^b ; it happens here, as it generally does, that when *Experiments* and *Observations* are grown into an Art ; the *Mathematical* and *Practical* Parts of that Art improve, whilst its *Physical* Part is deserted. It has fared somewhat better with *Opticks* ; which considers not only Painting, Beauty and Symmetry, but all visible Objects ; whereas Musick confines itself only to harmonick Tones ; which is a narrow Field : But the Business of *Sound* and *Hearing* should be well laboured in all its Parts ; and brought into a full and extensive *History*^c.

^a See this Direction explained in the *Novum Organum*, Part I. Sect. II, 18, &c.

^b See the *Article* MUSICK.

^c The following is a large *Example* of a *History* conducted according to the Direction of the *Novum Organum* ; and a Specimen how all the *Articles* of the *Sylva Sylvarum* would have been treated, had the Author lived to execute his vast Design. Indeed the present *Enquiry*, tho not finished, is prosecuted to such a length as might recommend it to a place in the fourth Part of the *INSTAURATION* ; if the Author had not here intended it as a Model of his Method of prosecuting Enquiries ; so as in the *Third Part* of his *grand WORK*, to give some Earnest of the *Fourth* : which is a Rule he appears to observe in all the *Parts* that are touched upon.

*A Table of Enquiry, for the particular HISTORY of
PHONICKS.*

A R T I C L E I.

O F the Existence and Non-existence of Sounds.

A R T I C L E II.

Of the Production, Conservation, and Propagation of Sounds.

A R T I C L E III.

Of the Magnitude, Smallness, and Damps of Sounds.

A R T I C L E IV.

*Of the Loudness, or Softness of Sounds, and their Propagation to
longer or shorter Distances.*

A R T I C L E V.

Of the Communication of Sounds.

A R T I C L E VI.

Of the Equality and Inequality of Sounds.

A R T I C L E VII.

Of the more Treble and more Bass Tones, or Musical Sounds.

A R T I C L E VIII.

Of the Proportion of Treble and Bass Tones.

A R T I C L E IX.

Of External and Internal Sounds.

A R T I C L E X.

Of the Articulation of Sounds.

A R T I C L E XI.

*Of the Duration of Sounds; and the Time they require in their Gene-
ration or Propagation.*

A R T I C L E XII.

Of the Direction of Sounds.

A R T I C L E XIII.

Of the Passage and Interception of Sounds.

A R T I C L E XIV.

Of the Medium of Sounds.

A R T I C L E XV.

Of the Figures of the Concaves, or Bodies thro' which Sounds are convey'd.

A R T I C L E XVI.

Of the Mixture of Sounds.

A R T I C L E XVII.

Of the Melioration of Sounds.

A R T I C L E XVIII.

Of the Imitation of Sounds.

A R T I C L E XIX.

Of the Reflexion of Sounds.

A R T I C L E XX.

Of the Relation and Difference betwixt Light and Sound.

A R T I C L E XXI.

Of the Sympathy and Antipathy of Sounds with one another.

A R T I C L E XXII.

Of the Means of Hindering or Improving the Hearing.

A R T I C L E XXIII.

Of the spiritual and fine Nature of Sounds^d.

S E C T. I.

*Of the Existence and Non-existence of Sounds.**Instances of
great Motions
without Sound.
In the Cele-
stial Bodies.*

I. **L**ET us first consider what great Motions there are in Nature, that pass without Sound, or Noise. The Heavens revolve in a rapid Motion, without Noise; tho, by some Dreamers, they have been said to make excellent Musick. The Motions of the *Comets* yield no Noise. And if it be thought that the greatness of their Distance will not let the Sound

^d These are the several ARTICLES, or HEADS OF ENQUIRY, which occur upon the first sedate Consideration of the Subject; and which, being duly enlarged, enquired into, and the necessary Experiments, Observations and Instances produced, lead to a Knowledge of its Nature and Properties; or what, in the Language of the Author, is term'd its FORM. But till these Articles are all filled up, the Instances produced, and the whole extended, verified, and deduced into Axioms, 'tis no more than a Sylva, or bare Collection of the Materials for a particular History of Phonicks.

Sound be heard ; we say that Lightnings, and Coruscations, which are near at hand, yield no Sound : yet in all these, there is a Percussion and Separation of the Medium.

2. The Winds in the upper Region, blow without Noise. The lower *Winds*, Winds, in an open Plain, make no Noise ; unless they be violent : but among Trees their Noise is perceptible. And the Sound of Winds is generally unequal, or in the way of rising and falling ; and sometimes, when vehement, trembling at the height of their Blast.

3. Rain or Hail, tho falling violently, yield no Noise in passing thro' the *Waters*. Air, till they reach the Ground, Water, Houses, or the like. The Water of a River is not heard in the Channel ; but runs silent, if it be of any depth : whilst the smaller Streams upon Shallows of Gravel, or Pebble, make an audible Noise. And Waters when they beat upon the Shore, or are straitned, as in the Falls of Bridges, or when dashed against themselves, by Winds, make a loud roaring.

4. Any piece of Timber, or hard Body, being thrust forwards by another contiguous to it, without knocking, gives no Noise. And so Bodies in weighing upon one another, tho the upper press the lower, make no Noise. Thus the Motion in the minute Parts of any Solid, passes without Sound ; the Sound being here produced only by the breaking of the Air, and not by the impulse of the Parts : so that where the anterior Body gives way as fast as the posterior comes on, no Noise is made ; be the Motion ever so great or swift.

5. Air open, and at large, makes no Noise, unless it be sharply struck ; *Instances of smaller Motions, with and without Sound. In Musical Instruments, &c.* as in the Sound of a String ; where the Air is briskly struck by a hard and stiff Body : for if the String be not strain'd, it makes no Noise. But where the Air is confin'd and straitned ; the Breath, or other blowing, with a gentle Percussion, suffices to create Sound ; as in Pipes, and Wind-Instruments. But in Flutes, which require only a soft Breath, the Concavity of the Instrument would yield no Sound, were it not for the Fipple that straitens the Air. Other Wind-Instruments, as Trumpets, Cornets, Horns, &c. require a forcible Breath ; as appears by the inflated Cheeks of the Blower. Organs also are blown with a strong Wind, by the means of Bellows. And some kinds of Wind-Instruments are sounded at a small Hole on the side, which straitens the Breath at the first Entrance : and this the rather, on account of their Traverse and Stop above the Hole ; which performs the part of the Fipple, in Flutes and Fifes, that give no Sound when blown at the wrong end, as Recorders do. So in Whistling, 'tis usual to contract the Mouth ; and to make the Tone more sharp, they sometimes use the Finger. But if a Stone, or a Dart, be thrown in the open Air, they give no Sound : no more do Bullets, unless they happen to be a little hollow'd in the casting ; which hollowness receives and confines the Air^e. Arrows, likewise, whiz not

B b 2

in

^e As the German Flute, for Instance.

^f Suppose a Brass Bullet turned exactly smooth, and discharged in the common manner ; will it make no sensible whizzing as it flies thro' the Air ?

in their Flight, except their Feathers are ruffled ; which likewise obstructs and confines the Air. But small Whistles give a Sound, on account of their extreme slendernefs ; whereby the Air is more confin'd than in a wider Bore. Again, the Voices of Men, and other Animals, pass thro' the Throat ; which confines the Breath. The *Jews-Harp* requires but a small Percussion ; and has also the advantage of confining the Air in the Mouth.

*Solids, Air,
and Flame.*

6. Solid Bodies, if gently struck, give no Sound ; as when a Person treads softly upon a Floor. So Chests or Doors in dry Weather, when they open easily, make no Noise : and Cart-wheels squeak not if they are greased. The Flame of Tapers, tho it be a swift Motion, and breaks the Air, yet passes without Sound. The Air in Ovens, tho it doubtless boils, as it were, dilates itself, and is beat back ; yet makes no Noise. Flame repulsed by Air, affords a Noise ; as in blowing the Fire with Bellows ; greater than if the Bellows were to blow upon the Air itself. So likewise Flame striking the Air strongly, makes a Sound : and great Flames, roar whilst one impells another.

White Powder.

7. There goes a Rumour of a kind of *white Gunpowder*, which will discharge a Piece without Noise : and it is a dangerous Experiment if true^z. But it seems to me impossible ; for if confined Air be driven out, and strike the open Air, it will certainly make a Noise^a. As for the *white Powder*, it may be a mixture of *Nitre*, Sulphur, and a little Camphire, without Coal ; for Nitre alone will not take Fire : nor is it probable, that the Sound shou'd be damp'd or deaden'd by discharging the condensed Air, before it comes to the Mouth of the Piece, and the open Air ; for it will thus only make more divided Sounds. If it were possible, there should be no Air confined at the Mouth of the Piece, the Bullet might go away with little Noise : For the Percussion of the Flame upon the Bullet, makes no Noise : the Bullet in passing thro' the Air, makes but little ; and if no confined Air were to strike upon the open Air, there is no Cause of Sound ; yet the Bullet's Motion will not be stopped. So that the trial may be made, by filling a little hollow metalline Cylinder with Powder ; and laying the Bullet in the Mouth of it, so as to reach half out into the open Air.

Burning-Glasses.

8. I heard it affirm'd by a great, tho vain, Dealer in Secrets, that there was a Conspiracy, which himself hindred, to have kill'd Queen *Mary*, Sister to Queen *Elizabeth*, by a *Burning-Glass*, from the Leads of the House, as she walked in *St. James's Park*. And if Burning-glasses could be brought to a great degree of strength, (and they talk of Glasses able to fire a Navy) the

^z White Gunpowder has frequently been made by using *Touch-wood*, which is white, instead of Willow-Coal, which being black, communicates a dusky Hue to the common Gunpowder. But this kind of white Powder still makes a Report ; so does the common white *Pulvis fulminans* : but what approaches the nearest of any thing yet discovered, to the Design of the *white Powder* here understood, is, perhaps, *condensed Air*, in the *Wind-Gun* ; which, when well made, is indeed a highly dangerous and destructive Engine ; capable of doing Execution, where its slender and short-lived huffing Report cannot be heard.

^a So it does in the *Wind-Gun* ; but nothing like the Noise of *Gunpowder*, even when the *Wind-Gun* is high charged with condensed Air ; so as to throw out twenty Bullets successively ; in the space of a Minute.

the Percussion of the Air alone, by such a *Burning-glass*, would make no Noise; any more than Coruscations and Lightnings, without Thunder.

9. I suppose the Impression of the Air by *Sounds*, requires time to reach the Sense, as well as the Impression of visible Objects; and will not otherwise be heard. Therefore, as a Bullet from a Cannon, moves so swift, as to be invisibleⁱ; the same swiftness of Motion makes it inaudible: for the apprehension of the Eye, is quicker than that of the Ear.

10. All Eruptions of Air, tho small and light, cause the *Sounds* called crackling, puffing, spitting, &c. as in Salt, Bay-leaves, and Chestnuts, thrown into the Fire: So Candles will spit Flame, if they be wet, &c.

Time required to render Sounds perceptible.

The smaller Sounds, by Eruption of Air.

S E C T. II.

Of the Production, Conservation, and Propagation of Sounds.

1. **T**HE Cause commonly assign'd of Sound, viz. the *Elision of the Air*^k, is but a Term of Ignorance; and the Notion but a catch of the Wit upon a few *Instances*; as the manner is, in the received *Philosophy*. And 'tis a common way with Men, when once they have got a pretty Expression, or a Term of Art, by the End; to let it go current: tho it be empty of Matter. This Conceit of *Elision* appears manifestly false; because the Sound of a Bell, a musical String, or the like, continues melting for some time after the Percussion; but ceases presently, if the Bell, or String be touched and stayed: whereas if an *Elision of the Air* made the Sound; the touch of the Bell or String could not so suddenly extinguish the Motion caused by an *Elision of the Air*. This appears still more plain by chiming, with a Hammer, upon the out-side of a Bell; for the Sound will thus be made according to the inward Concave of the Bell: whereas the *Elision of the Air* can be only between the Hammer and the out-side of the Bell. So again, if *Elision* were the Cause; a broad Hammer, and a Bodkin, struck upon Metal; would give different Tones, as well as a different Loudness; which they do not: for tho the Sound of the one be louder, and of the other softer; yet the Tone is the same^l. Besides in *Echoes*, whereof

ⁱ Red hot Bullets discharged in the dark are visible: and so, perhaps, are *Brass Bullets* discharged by Day; when the Spectator stands with his back to the Sun, whilst the Sun's Rays play directly upon the Ball in its Motion.

^k That is in plain Words, the Squeezing, Pressing, or Cutting of the Air; as betwixt the Hammer and Anvil the Bell and its Clapper, the Finger and a musical String, &c.

^l 'Tis a Difficulty with many to acquire a just Notion of this Matter; and the Thing itself is seldom clearly made out, how a Bell, or a musical String, struck in any Part, or with any degree of Force, should still give one and the same Tone; differing only in Loudness or Lowness. The Knowledge of this is rather to be acquired by the Ear, and Experience, than by Words. But if farther Direction be required, consult Mr. *Malcolm's Treatise of Musick*. See also below, SECT. IV. and VIII.

whereof some are as loud as the original Voice, there is no new *Elision*; but only a Repercussion. These and the like Conceits, will scatter and break up like a Mist; when Men shall have cleared their Understanding, by the Light of Experience.

That local Motion of the Air is not necessary to Sound.

2. 'Tis certain, that *Sound* is not produced at the first, without some local Motion of the Air, Flame, or other Medium; nor without some Resistance, either in the Medium or Body struck. For a mere yielding, or cession, produces no Sound. And herein Sounds differ from Light and Colours, which pass thro' the Air, or other Medium; without any local Motion of the Air, either at the first, or after. But we must attentively distinguish between the local Motion of the Air, and the Sounds conveyed in the Air. As to the former, we manifestly perceive, that no Sound is produced without a perceptible blast of the Air; or without some resistance of the Air that is struck. For even Speech, one of the gentlest Motions of Air, is attended with the Expulsion of a little Breath. And all Pipes or Wind-Instruments have a Blast, as well as a Sound. We find also that Sounds are carried by the Wind, and therefore will be heard farther with the Wind, than against it; and that they likewise rise and fall with the intension or remission of the Wind^m. But for the Impression of *Sound*, 'tis quite another thing; and entirely without any perceptible local Motion of the Air: in which it resembles *Vision*ⁿ; for after a Bell is rung, we discern no perceptible Motion of the Air, in the track where the Sound goes, but only at the first. Nor does the Wind, in carrying a Voice, by its Motion, confound any of the delicate and articulate Figurations of the Air, in the variety of words. And to speak loud against the Flame of a Candle, will not make the Flame tremble considerably; tho' most when those Letters are pronounced which contract the Mouth; as F, S, U, &c. But gentle Breathing, or Blowing, without speaking, will move the Flame much more. And probably Sound is the rather without any local Motion of the Air; because, as it differs from Sight, in requiring a local Motion at first; so it resembles it in many other Things, which induce no local Motion^o.

Seeming Instances of the contrary.

3. On the other Hand, Glass Windows will shake with Thunder, and the firing of Ordnance; and Fishes are thought to be frightened with the Motion, caused by Noise upon the Water: But these effects proceed from the local Motion of the Air, which is a Concomitant of the Sound; and not from the Sound itself. It is also said, that violent Shoutings of People in great Multitudes, have so rarified the Air, that Birds upon the Wing have fallen down; the Air being thus render'd unable to support them^p. And 'tis believed

^m See Mr. Derham's Paper upon the Motion of Sound, in the *Philosophical Transactions*, N^o 313.

ⁿ See the Bishop of Fern's Paper upon *Acousticks*, in the *Philosophical Transactions*, N^o 156. And Dr. Grandi's Considerations upon it, N^o 319.

^o See the Paper above cited.

^p Allowing that Birds have been made to fall down by loud Shouting, it does not follow that the Air must have been rarified by the Noise: for the Birds may only be thus frightened by the Noise, so as to fall down.

lieved by some, that violent ringing of Bells in populous Cities, has chased away Thunder; and also dissipated pestilent Air: all which *if real*, may proceed from the *Concussion of the Air*, and not from the Sound. A very great Sound, near at hand, has struck many with deafness; and at the Instant they have found, as it were, the breaking of a Skin or Parchment in their Ears⁹: and myself standing near a Person who lured loud and shrill, suddenly received an Injury; as if somewhat had broke, or been dislocated in my Ear; and immediately after ensued the Sensation of a loud Ringing; so that I apprehended some Deafness: But it vanished in half a quarter of an Hour. This effect may be justly refer'd to the Sound; for an over potent Object destroys the Senses: and spiritual Species, both visible and audible, will affect the Sensories, tho they move no other Body.

4. In the *Propagation of Sounds*, Enclosure of them preserves, and carries them farther. Thus in Rolls of Parchment, or shooting Trunks, the Mouth being applied to one end of the Roll or Trunk, and the Ear to the other; the Sound is heard much farther than in the open Air: for the Sound spends and dissipates in the open Air; but is conserved and contracted in such Concaves. So, if one Man speak in the Touch-hole of a piece of Ordnance; and another apply his Ear to the Mouth of the Piece; the Sound is much better heard than in the open Air. 'Tis farther to be considered, what the Event will prove, when the Sound is not enclosed all the Length of its way, but passes in part thro' open Air; as when one speaks at some distance from a shooting Trunk; or where the Ear is at some Distance from the other end of the Trunk; or where both the Mouth and Ear are distant from the Trunk. It has been found that in a Trunk of eight or ten Foot, the Sound is helped, tho both the Mouth and the Ear be four or five Inches from the Ends of the Trunk; and somewhat farther assisted when the Ear of the Hearer, than when the Mouth of the Speaker, is near. And 'tis certain, that a voice is better heard within a Chamber from without, than without from within the Chamber. And as an entire Enclosure preserves the Sound, so does a Semi-concave; tho in a less degree. Therefore, if a Person speak at one end of a half Tube, or Trunk, and you lay your Ear to the other; this will carry the Voice farther, than to speak in the Air at large. Nay, if it be not a Semi-concave; but the like be done along the Mast of a Ship, or the outside of a piece of Ordnance; tho this be on a Convex Surface, the Voice will be heard farther than in the open Air. It should be tried, how; and with what proportion of Disadvantage, the Voice will be carried in a Horn, or an arch'd Line; or in a Trumpet, which is a retorted Line; or in a Pipe, that is sinuous[†].

5. 'Tis certain, that Sounds are producible without Air; tho this be the most favourable Medium thereof. For a pair of Tongs open'd and shut at some depth within Water, may be heard without any great Diminution of the Sound; tho there is no Air at all present. Take one Vessel of Silver, and

Sounds preserved by Enclosure.

Sounds producible without Air, viz. in Water.

⁹ Hence, perhaps, some Countenance to the Opinion, that the Drum of the Ear was the Instrument of Hearing. But this is not well confirmed.

[†] There remain many Experiments of this kind to be tried.

and another of Wood, fill each of them with Water, and then strike the Tongs together, as before, about four Inches from the Bottom; and the Sound in the Silver Vessel will be much more resonant than in that of Wood: yet if there be no Water in the Vessel, so that the Tongs play in the Air, there will be no difference between the Sound coming from the silver or the wooden Vessel. Whence, besides the capital Point of producing Sound without Air, we may collect, that the Sound communicates with the bottom of the Vessel; and that such a Communication passes better thro' Water than Air.

In Flame.

6. Strike any hard Bodies together, in the midst of Flame; and the Sound will differ little from the Sound in Air.

By means of the pneumatical Parts in Bodies.

7. The pneumatical Part, which is in all tangible Bodies, and has some Affinity with Air, performs, after a sort, the Office of the Air: Thus the Sound of an empty Barrel, is in part, created by the Air on the outside; and in part, by that in the inside; for the Sound will be less, or greater, as the Barrel is more or less empty: tho' it communicates also with the Spirit in the Wood, thro' which it passes from the outside to the inside. So likewise in the Chiming of Bells on the outside; the Sound passes to the inside.

The Physical Production of Sound in Strings.

8. It were gross to think, that the Sound in Strings is produced between the Finger and the String: for these are but Preparatories to the production of the Sound, which is form'd between the String and the Air; and that not by any impulse of the Air, from the first Motion of the String; but by the return of the String (now strain'd by the Touch) to its former place: which Motion of Return, is quick and sharp; whereas the first Motion is soft, and dull. So the Bow tortures the String continually, and thereby holds it in a constant Trepidation.

S E C T. III.

Of the Magnitude, Smallness, and Damps of Sounds.

The ways of increasing the strength and deepness of Sounds in Horns.

1. **L**ET one Person whistle at one end of a shooting Trunk, whilst another holds his Ear at the other end; and the Sound will strike the Ear so sharp as to be scarce tolerable: for Sound naturally diffuses in a Sphere, and so spends itself; but if made to go in a Canal, it must needs acquire greater Force: And thus Enclosures not only preserve, but also increase and sharpen Sounds^f. A French Horn being greater at one

^f Does not this Experiment give some Light to the Bishop of Fern's first and second Problem; viz. (1.) To make the least Sounds, by the help of Instruments, as loud as the greatest; a Whiffer to become as loud as the Report of a Cannon? and, (2.) To propagate any, the least, Sound to the greatest Distance? Whoever understands the Scope and Tendency of the present Enquiry, will not, perhaps, be at a Loss, to make several Discoveries in Phonicks, intimated, but not divulged, by that learned Prelate; and even to carry the Doctrine of Acousticks, Diacousticks, and Catacousticks farther than his Intimations reach. See Philosophical Transactions, N^o 319. And consult Dr. Hook's Posthumous Works.

one end than at the other, increases the Sound more than if the Horn were of an equal Bore : for the Air and Sound, being first contracted at the lesser end, and afterwards having more room to spread at the greater, dilate themselves ; and in coming out strike more Air, whereby the Sound is render'd larger and deeper. And even Hunters Horns, which are commonly made strait, not oblique as the former, are always greater at the lower end. It should be tried also in Pipes, made much larger at the lower end : or with a Belly towards the end, and then issuing in a strait Concave again.

2. There is in St. James's Fields a Conduit of Brick, with a low Vault adjoining ; and at the end of that, a round House of Stone : in the Brick Conduit is a Window ; and in the round House, a small slit ; so that when a Person hollows in the slit, it makes a fearful roaring at the Window. For all Concaves that proceed from narrow to broad, amplify the Sound at coming out. *In particular Buildings.*

3. Hawks-Bells, that have Holes in the Sides, give a greater Ring, than if the Pellet struck upon Brass in the open Air. For the Sound inclosed by the sides of the Bell, comes out at the Holes unspent, and stronger. And in Drums, the closeness round about, that preserves the Sound from dispersing, makes the Noise come out at the Drum-holes, much louder and stronger, than if the like Skin were struck, extended in the open Air. *In Hawks Bells and Drums.*

4. Sounds are heard better and farther in an Evening, or in the Night, than at Noon, or in the Day : because in the Day, when the Air is thinner, the Sound pierces more ; but when the Air is thicker, as in the Night, it spreads less : as being now in a degree of Enclosure. 'Tis true also, that the general silence of the Night contributes to this Effect. *Sounds heard farther by Night than by Day.*

5. There are two kinds of Reflexion in Sound ; the one at a Distance, or the Echo ; wherein the Original is heard distinctly, and the Reflexion also distinctly : the other in Concurrence ; when the Sound reflecting near, returns immediately upon the Original, and so repeats it nor, but amplifies. Whence Musick upon the Water sounds sweeter ; and better in Chambers that are wainscotted, than such as are hung ^r. *Two kinds of Reflexion in Sounds.*

6. The Strings of a Lute, Viol, or Virginal, give a much greater Sound, on account of the Knot and Concavity beneath, than if there were only a flat Board without that Hollow and Knot, by which the upper Air communicates with the lower. An Irish Harp admits the open Air on both sides of the Strings : and its Belly runs not along with the Strings, but lies at the end of them. It makes a more resonant Sound than the Bandora, Orpharion, or Cittern ; tho these have Wire-strings as well as that. The Cause seems to be, that the open Air on both Sides helps where there is a Concavity ; which is therefore best placed at the End. A Virginal, when the Lid is down, makes a slenderer Sound than when the Lid is up : for all shutting in of Air, where there is no competent Vent, damps the Sound. *The Advantage of Concavities and Sound-boards in Musical Instruments.*

V O L. III.

C c

There

* These Particulars deserve to be compared with those mentioned by the Bishop of Ferns, in the Paper so often cited ; which may shew upon what Foundation he proceeded to build his highly useful and extensive Doctrine of Acousticks.

*The Observa-
tion transfer-
red to the
Structure of
particular
Places in
Churches, &c.*

7. There is a Church at *Gloucester*, (and I have heard the like of other Places) where, if a Person speaks softly against a Wall; another shall hear his Voice better, at a considerable distance, than near at hand^v: enquire more particularly of the Structure of that Place^u. I suspect there is some Vault, or Hollow, or Isle, behind the Wall; and some Passage to it from the farther end of that Wall, against which the Person speaks; so that the Voice slides along the Wall, then enters at some Passage, and communicates with the Air of the Hollow: for 'tis somewhat preserved by the plain Wall; but that is too weak to give an audible Sound, till it has communicated with the back Air^w.

*Instances to
shew that
Sounds com-
municate with
the Spirits of
Bodies.*

8. Place the Horn of the Bow near your Ear, then touch the String, and the Sound will be increased to a degree of Tone: the *Sensory*, in this case, by reason of the near approach, being struck before the Air disperses. The like happens, if the Horn be held betwixt the Teeth: but this is a plain Propagation of the Sound from the Teeth to the Organ of Hearing; for there is a great Intercourse between these two Parts; as appears from hence, that a harsh, grating Tune sets the Teeth on edge. The same thing happens if the Horn of the Bow be applied to the Temples; the Sound thus sliding from thence to the Ear. If a Rod of Iron, or Brass, be held with one end to the Ear, and the other be struck upon, it makes a much greater Sound than the same Stroke upon the Rod, when not so contiguous to the Ear. By which, and other *Instances*, it should seem that Sounds do not only slide upon the Surface of a smooth Body; but also communicate with the Spirits in the Pores of the Body^x.

*Instances,
shewing that
Concavities
magnify
Sounds.*

9. In *Trinity-College, Cambridge*, there was an upper Chamber, weak in the Roof, and therefore supported by an Iron Prop, as thick as a Man's Wrist, placed in the middle of the Chamber: which Iron, if struck, would make only a little flat Noise in the Room; but a great Bomb in the Chamber below. The Sounds made by Buckets in a Well, when they strike against the Sides, or plunge into the Water, &c. are deeper and fuller than if the like Percussion were made in the open Air: on account of the Confinement and Inclosure of the Air in the Concave of the Well. So empty Barrels placed in a Room under a Chamber, make all the Sounds in the Chamber more full and resounding. Hence there are *five general Ways of increasing Sounds*^y; viz. (1.) *simple Enclosure*^z; (2.) *Enclosure with*

^v On this Property of Sound, arising from the Structure of a Place, may depend the *Bishop of Ferns's* third and last Problem; viz. *To convey a Sound from one place to another, at a great distance; so as that it shall not be heard in the middle.*

^u Consider the Nature of *Whispering Galleries*, as, particularly, at *St. Paul's in London*.

^w He who shall make himself Master of the Nature and Properties of Sounds, will, perhaps, have it in his power to perform as surprizing things as *Friar Bacon* is said to have done, by his Skill in Opticks, and, probably, more serviceable

^x Something to this Purpose was intimated above, *Secl. II. 7.*

^y Observe, with regard to the *Method of the Enquiry*, the Use of particular *Instances* and *Experiments*; none of which are to be collected and made for their own sakes, but to furnish the Means of *Induction*, and *Axioms* that lead to capital Works.

^z As in cylindrical Tubes.

with Dilatation^a; (3.) Communication^b; (4.) Approach to the Sensory^c; and (5.) concurrent Reflection^d.

10. With regard to Exility of Sounds; 'tis certain the Voice passes through solid and hard Bodies, if they be not too thick; and again, through Water: but then the Voice is, by such a Passage, reduced to a great Exility. Thus, if the Holes of a Hawk's Bell be stopped, it will not ring; but rattle like the Eagle-stone, which contains another Stone within it. And as for Water; take a Pail, turn the Bottom upward, and carry the Mouth of it down to the Level of the Water; plunge it six Inches deep, still keeping it even, that it may not tilt on either side, and so the Air get out: then let a Person dive so far under Water, as to put his Head into the Pail; and there will come out as much Air in Bubbles as to make room for his Head. Now let him speak, and his Voice will be heard plainly; tho now made extreme sharp, like the Mock-voice of Puppets; yet the articulate Sounds of the Words will not be confounded. It may be more commodious to put the Pail over a Man's Head above Water; then, he sinking down, to press the Pail down with him, so that by kneeling or sitting, he may be lower than the Water.

That Sounds pass through both Solids and Fluids, but are thus rendered exile.

11. In Lutes, and stringed Instruments, if you stop a String high, whereby it has less scope to tremble, the Sound is more treble, but more dead. Take two Saucers, and strike the Edge of the one against the Bottom of the other, within a Pail of Water; and as you put the Saucers lower and lower, the Sound will grow flatter, even while part of the Saucer is above the Water; but that flatness of Sound is joined with a harshness, caused by its Inequality; as coming from the parts of the Saucer that are under the Water. But when the Saucer is wholly under the Water, the Sound becomes clearer, tho much lower; as if it came from afar.

Instances in musical Strings, and metalline Vessels struck in Water.

12. Soft Bodies damp Sound much more than hard ones. Thus, if a Bell be wrapped round with Cloth or Silk; it deadens the Sound more than if the Bell were surrounded with Wood. Trial was made in a Recorder, and varied several Ways: the Bottom of it was stopped, (1.) with Wax; (2.) set against the Palm of the Hand; (3.) against a Damask Cushion; (4.) placed in Sand; (5.) placed in Ashes; and, (6.) set half an Inch deep in Water, close to the Bottom of a Silver Bason; and still the Tone remained: but when the Bottom of it was set against, (1.) a woollen Carpet; (2.) a plush Lining; (3.) a Lock of Wool, tho loose; and, (4.) against Snow; the Sound of it was quite deadened, and no more than a Breath.

That soft Bodies deaden Sounds more than hard ones.

13. Hot Iron produces not so good a Sound as cold; for, while hot, it appears to be more soft, and less resounding. So likewise, warm Water in falling, makes not so full a Sound as cold; being, I conceive, softer, and nearer the nature of Oil; for 'tis more slippery, and scowers better.

Extended to Iron and Water, hot and cold.

C c 2

14. Let

^a As in speaking Trumpets, &c.

^b As in Harps, &c. where the Air communicates on both sides.

^c As when the Ear is close applied to the sounding Body.

^d As in speaking near hollow Vessels, &c. Could not various particular Methods, capable of producing great Effects, be found, by an artificial Application, or Combination, of two, or more of these?

Two Experiments of Light directed.

14. Let a *Recorder* be made with two Fipples, at each end one ; the Trunk as long as two Recorders, and the Holes answerable towards each End : let two Persons play the same Lesson upon it in Unison ; and observe whether the Sound be confounded, or augmented, or deadned. So likewise, let a Cross be made of two hollow Trunks ; and let two Persons speak, or sing ; the one lengthwise, the other transverse : and let there be two Hearers at the opposite Ends ; to observe whether the Sound be confounded, augmented, or deadned. These two *Instances* will also give light to the mixture of Sounds *.

Bellows applied to the Hole of a Drum.

15. Bellows being blown in at the Hole of a Drum, whilst the Drum beats, makes it sound a little flatter, without any other apparent Alteration. The Cause is, that the Bellows in part prevent the issuing of the Sound ; and in part also make the Air less moveable.

S E C T. IV.

Of the Loudness or Softness of Sounds, and their Propagation to Longer or Shorter Distances.

The strength of Percussion, a principal Cause of the Loudness and Softness of Sounds.

1. **T**HE Loudness and Softness of Sounds, is a thing distinct from their Magnitude and Exility ; for a bass String, tho gently struck, gives the greater Sound ; but a treble String, if hard struck, will be heard much farther : because the bass String strikes more Air, and the treble less, but sharper. The strength of Percussion is, therefore, a principal Cause of the loudness and softness of Sounds ; as in knocking harder or softer ; winding a Horn stronger or weaker, &c. And the strength of this Percussion consists as much in the hardness of the Body struck, as in the force of the striking Body : for if you strike Cloth, it gives a less Sound ; if, with the same force, Wood, a greater ; if Metal, a still greater. And, in Metals, Gold gives the flatter Sound ; and Silver, or Brass, the more ringing Sound. But Air, where strongly confined, resembles a hard Body : whence the loud Noise in discharging a Cannon. We find also, that a Charge, whether with Bullet, or Paper, wet and hard stopped, or with Powder alone, rammed hard, makes no great difference in the loudness of the Report.

Sharpness of Percussion, a Cause of loudness and strength in Sounds.

2. The sharpness or quickness of the Percussion, is a great cause of the loudness, as well as the strength. So if you strike the Air with a Whip, or a Wand, the sharper and quicker it is done, the louder Sound it makes. And in playing upon the *Lute*, or *Virginal*, the quick Touch adds great life

* Perhaps these two Experiments have not hitherto been tried ; at least, I have not met with them in any other Author ; tho, possibly, the Bishop of *Ferns* knew their Success ; if we may conjecture from his Intimation of an uncommon Method of mixing Sounds ; and making a *Consort* with a single Instrument. Let the Nature and Application of *echoing* and *whispering Places*, be considered upon this Occasion. But, for the Mixture of Sounds, see more hereafter, *Sett. XVI.*

life to the Sound : the quick Stroke cutting the Air suddenly ; whilst the soft one rather beats than cuts it ^f.

S E C T. V.

Of the Communication of Sounds.

1. **A**N apt Experiment for demonstrating the *Communication of Sounds*, *That Sounds communicate, shewn in Bells;* is the chiming of Bells ; for if you strike with a Hammer, first upon the upper part of the Bell, then upon the middle, and lastly upon the lower part ; you will find the Sound to be more treble or more bass, according to the Concavity on the inside ; tho the Percussion be only on the outside.

2. When the *Sound* in Wind-Instruments is produced between the Blast of the Mouth, and the Air of the Instrument, it has yet some *Communication* with the Matter of the Sides of the Instrument, and the Spirits therein contained ; for in a Flute, or Trumpet of Wood and another Brass, the Sound will be different : so if the Flute be covered with Cloth or Silk, it gives a different Sound from what it would do of itself ; and if the Flute be a little wet on the inside, it will make a different Sound from the same Flute dry ^g.

S E C T. VI.

Of the Equality and Inequality of Sounds.

1. **W**E come next to such *Inequality of Sounds* as proceeds, not from the nature of the Bodies themselves, but is accidental ; either through the roughness or obliquity of the Passage, the doubling of the Percutient, or the trepidation of the Motion. A Bell if crack'd, whereby the Sound has not a clear Passage, rings hoarse and jarring ; so the human Voice, becomes hoarse, when by a Cold the Wind-pipe grows rugged and furred. And in these two *Instances* the Sounds are ungrateful, because totally unequal ; but when unequal in Equality, they prove grateful, tho purling.

The Inequality of Sounds in crack'd Bells; and hoarse Voices.

2. All Instruments that have either Returns, as *Trumpets* ; Flexures, as *Cornets* ; or are elevated and depressed, as *Sackbuts* ; yield a purling Sound : but the Flute, that has none of these Inequalities, gives a clear Sound. Yet the Flute itself moistened a little on the inside, sounds more solemnly, and with

That Instruments have different Sounds according to their Figures.

^f See this *Article* farther prosecuted in Mr. Malcolm's *Treatise of Musick*, CHAP. I. and M. Perault's *Essais du Bruit*. There are also certain Papers in the *Philosophical Transactions*, and *French Memoirs*, that give light to this Subject.

^g Some Particulars relating to this *Article*, have been already treated occasionally, under Sect. III.

with a degree of purling or hissing. And a wreathed String, such as the bass Strings of a *Bandora*, also yields a purling Sound.

The Observation extended to musical Strings.

3. But a *Lute String*, if it be altogether unequal in its Parts, gives a harsh and untuneable Sound ; which kind of Strings we call *false Strings*, as being bigger in one part than another : whence Wire-strings are never false. So, to try a *Lute String*, we extend it hard between the Fingers, and fillip it ; and if it give a double Species, it is *true* ; but if more, it is *false*^h.

Instances where Water gives a purling Sound.

4. The running of Waters affords a trembling Noise ; and in *Regals*, which have a Nightingal-pipe that contains Water, the Sound is continually tremulous. There is also a Play-thing for Children called *Cocks* ⁱ, with Water in them ; which, when blown into, yield a trembling Sound : and this trembling of Water has an Affinity with the Letter *L*. And all these Inequalities of Trepidation are rather pleasant than otherwise.

Why the Tenor is the sweetest part in Musick.

5. All bass, or very treble Notes, give a rough Sound ; the Bass striking more Air than it can well strike equally : whilst the Treble cuts the Air so sharp, that it returns too swift to make the Sound equal ; and therefore the Mean, or Tenor, is the sweetest Part in Musick.

Why no voluntary Motion but the Voice, makes a musical, or immusical Sound, at pleasure.

6. We know nothing that can, at pleasure, make a musical or immusical Sound, by voluntary Motion, but the Voice of Man and Birds. The *Cause* is, no doubt, in the Wind-pipe ; which, being well extended, acquires an Equality ; as a Bladder that is wrinkled, becomes smooth when extended^k. The Extension is always greater in Tones than in Speech ; whence the inward Voice, or Whisper, can never give a Tone. And in singing, there is a greater Labour of the Throat than in speaking ; as appears from the thrusting out, or drawing in of the Chin, when we sing. The humming of Bees is an unequal Buzzing, conceived, by some of the Ancients, not to issue at the Mouth of the Creature ; but to be an inward Sound. It should rather seem to proceed from the motion of their Wings ; for it is not heard but when these stir.

The Sound of Metals quenched in Water.

7. All Metals quenched in Water give a hissing Sound ; (which has an Affinity with the Letter *Z* ;) notwithstanding the Sound is created between the Water, or Vapour, and the Air. Boiling also, if there be but little Water in a Vessel, makes a hissing Sound ; but boiling in a full Vessel makes a bubbling Sound, somewhat like that of the *Cocks* used by Children^l.

Experiments recommended for trying the Effects of unequal Mediums upon Sound.

8. Trial should be made, whether the Inequality of the Medium will not produce an Inequality of Sound ; as if three Bells were made, one within an-

^h I suppose this double *Species* is meant of the two *Sensations*, or *Sounds*, caused by the going, and returning of the String ; which Sounds will only be uniform, or equable, when the String is of the same Thickness in all the vibrating Parts.

ⁱ The Thing here meant, seems at present to be out of Use : 'tis a kind of *Bellied-Whistle*, made of *Earthen-Ware*, and filled with Water up to the Whistle-part ; whereat, when a Person blows, it yields a shrill, or very sharp Sound, with a considerable degree of Purling. By *Purling*, is understood, what may be otherwise called the *Jug*, or *quick Double* ; as in the Singing of the Nightingal, the Playing of a *Flageolet*, &c.

^k There is a curious Paper to this Purpose in the *French Memoirs*.

^l See above, § 4.

another, with Air between them ; and the outermost Bell were chimed with a Hammer ; how would the Sound differ from that of a single Bell ? So, likewise, join a Plate of Brass, and a Plank of Wood together ; and strike upon one of them, to try if they do not give an unequal Sound. Again, make two or three Partitions of Wood in a Hoghead, with Holes or Knots in them ; and mark the difference of their Sound from that of a Hoghead without such Partitions ^m.

S E C T. VII.

Of the more Treble, and the more Bass Tones, or musical Sounds.

1. **T**IS evident that the Percussion of a greater Quantity of Air, *The Cause of Bass and Treble Sounds,* causes the *Bass Sound* ; and the less Quantity, the *Treble*. The Percussion of the greater Quantity of Air, proceeds from the largeness of the striking Body ; and the length and breadth of the Concavity through which the Sound passes : whence a bass String is greater ; a bass Flute, wider than a treble ; and in *Pipes*, and the like, the lower the Note-holes are, and the farther from the Mouth of the Pipe, the more bass the Sound ; and the nearer the Mouth, the more treble : so, if you strike an entire Body, as an Andiron of Brass, at the Top ; it makes a more treble Sound ; and at the Bottom, a more bass. 'Tis also evident, that the sharper or quicker Percussion of the Air, causes the more treble Sound ; and a slower, or heavier, the more bass Sound. So in Strings, the more they are strained, the quicker they start back, and the more treble the Sound ; as, on the contrary, the slacker they are, the baser the Sound : and hence, a bigger String more stretched, and a smaller String less stretched, may fall into the same Tone.

2. Children, Women, and Eunuchs, have smaller, and shriller Voices *The Cause of breaking in the Voice,* than Men : not because Men have greater Heat, which may make the Voice stronger (for strength of Voice regards only loudness and softness, not *Tone* ;) but from the Dilatation of the Organ ; which, indeed, may proceed from Heat. But the *Cause* of changing in the Voice, at the Years of Puberty, is more obscure. It seems to be hence, that when much of the moisture of the Body, which before watered the Parts, is drawn down to the spermatick Vessels, it leaves the Body hotter ; whence the Dilatation of the Organs ⁿ :
for

^m He who desires to improve the present Set of *Musical Instruments*, or to invent new ones, with Advantages wanting in the present, should apply to the making of these kinds of *Experiments* ; without which, no just *Axioms* in *Physicks*, capable of directing the *Instrument-maker*, can be procured.

ⁿ *Viz.* the *Aspera Arteria*, or the Head of the *Larynx*, &c. and we certainly know that Heat has the Power of dilating, or expanding all the parts of the Body ; as well as rendering them dry. And, doubtless, these two Properties have a Power of altering Sounds, as all *Instances* confirm. However, the Point should be more accurately examined by *philosophical Anatomists*.

for all the Effects of Heat manifestly come on at this time ; as Pilosity, roughness of the Skin, hardness of the Flesh, &c.

*Three Ways of
straining musi-
cal Strings.*

3. The Industry of Musicians has invented two other Ways of straining Strings, besides winding : the one is, stopping them with the Finger ; as in the Necks of *Lutes*, *Viols*, &c. the other is, by shortening the Strings ; as in *Harps*, *Virginals*, &c. Both these depend upon the same Principle ; as they only cause the String to give a quicker Start. In straining of a String, the farther it is stretched the less super-straining goes to a Note ; for a String requires to be considerably wound, before it will make any Note at all : and in the Stops of *Lutes*, &c. the higher they go, the less distance there is between the Frets.

*The Tone of
Drinking-
glasses varies
with the
Quantity of
Water in them.*

4. If you fill a conical Drinking-glass with Water, then fillip it on the Brim, and afterwards empty part of the Water, and so more and more ; still trying the Tone by fillipping ; you will find the Tone more bass, as the Glass grows more empty.

S E C T. VIII.

Of the Proportion of Treble and Bass Tones.

*How to disco-
ver the Propor-
tion of Air
struck, in tre-
ble and bass
Tones.*

1. **T**HE just, and measured Proportion of the Air struck, with regard to the baseness, or trebleness of Tones, is one of the greatest Secrets in the contemplation of Sounds : for it discovers the true coincidence of Tones into *Diapasons* ; which is the Return of the same Sound : and so of the Concords and Discords between the *Unison* and the *Diapason*. This may be discovered, (1.) in the Proportion of the winding of Strings ; (2.) in the Proportion of the distance of Frets ; and, (3.) in the Proportion of the concavities of Pipes, &c. but more commodiously in the last.

*Viz. (1.) By
the winding of
Strings.*

2. But first try the winding of a String once about, as soon as it is brought to that Extension as to give a Tone ; then twice about, thrice, &c. and mark the Scale, or difference of the Rise of the Tone : whereby you will, at once, discover two Effects, or the Proportion of the Sound, in respect to the Winding ; and the Proportion of the Sound, in respect of the String, as it is more or less strained : but to measure this ; the Way will be, to take the length in a right Line of the String, upon any winding about of the Peg.

*(2.)
By the distance
of Frets.*

3. As for the *Stops* : take the number of Frets ; and, principally, the length of the Line from the first Stop of the String, to such a Stop as shall produce a *Diapason* to the former, upon the same String.

*(3.)
By the Bores of
Pipes.*

4. But, as we before observed, the thing will best appear in the Bores of Wind-instruments : let, therefore, six Pipes be made alike, in length and all things else ; only with a single, double, and so on to a sextuple Bore ; and mark what fall of Tone every one gives. But in these three *Instances* it must

must be diligently observed, what length of String, distance of Stop, and concavity of Instrument, gives what rise of Sound: thus, in the last case, you must set down what increase of Concavity goes to the making of a Note higher, what of two Notes, what of three; and so up to the *Diapason*: for then the great Secret of Numbers and Proportions will appear. Perhaps the Makers of Wind-instruments know this already; because they make them in Sets: and likewise Bell-founders, in adjusting the Tune of their Bells: so that Enquiry may here save Trial¹.

5. 'Tis observed by one of the Ancients, that an empty Barrel struck with the Finger, gives a *Diapason* to the Sound of the like Barrel when full; but how that should be, I do not well understand; because the striking of a Barrel, full or empty, scarce gives any Tone^m.

Whether the Sound of an empty Vessel, be the Diapason to that of the same Vessel, when full.

6. Some sensible difference is required in the Proportion of creating a Note, with regard to the Sound itself, which is passive; and that it be not too near, but at a distance: for in a Recorder, the three uppermost Holes yield one Tone; which is a Note lower than the Tone of the first three: and the like, no doubt, is required in the winding or stopping of Stringsⁿ.

The Creation of a Note requires a sensible difference from the Sound.

S E C T. IX.

Of External and Internal Sounds.

1. **T**HERE is another difference of Sounds, which we call *external* and *internal*. This is neither soft nor loud, bass nor treble; musical nor unmusical: and tho there can be no Tone in an external Sound; yet it may be both *musical* and *unmusical*. The *internal Sound* we mean, is rather an *Impulse*, or *Contrusion*; than an *Elision*, or cutting of the Air: so that the Percussion of the one, with regard to the other, differs as a Blow does from a Cut. In Speech, the Whisper, whether loud or soft, is an internal; but speaking out, an external Sound: whence we can never make a Tone, nor sing in Whisper; but in Speech we may. So Breathing, or blowing by the Mouth, Bellows, or Wind, tho loud, is an internal Sound; but the blowing through a Pipe, or Concavity, is an external one. So, likewise, the greatest Winds, if they have no Coarctation, or blow not hollow, give an internal Sound; but the whistling, or hollow Wind, yields a singing, or external Sound; the former being confined by some other Body; and the latter, confined by its own Density: and therefore when the

The Notion of an internal Sound illustrated.

V O L. III.

D d

Wind

¹ It should seem, that the Makers of Wind-instruments, and Bell-founders, have no exact Rule for this Purpose; or else no true Method of observing it: they, however, come tolerably near, by Habit and Practice, as it were mechanically; and afterwards by making some small Alterations, as *scraping* the Pipe, or *chipping* the Bell, bring the Tone to a Truth.

^m Perhaps the Vessel was not of Wood, but Metal. How does the thing succeed in Glass? See above, *Sett.* VII. 4.

ⁿ There seems to be something intimated here, with regard to the Creation of Notes, that has not hitherto been clearly and physically made out.

Wind blows hollow, 'tis a sign of Rain. So Flame, as it moves within itself, or is blown by Bellows, gives a Murmur, or internal Sound.

External and internal Sounds differently produced.

2. There is no hard Body, but when struck against another hard Body, will yield an external Sound, greater or less: inasmuch, that if the Percussion be over-soft, it may induce a Nullity of Sound; but never an internal Sound: as when one treads so softly as not to be heard. Where the Air, whether confined or not confined, is the Percutient against a hard Body, it never gives an external Sound; as in blowing strongly with Bellows against a Wall. Sounds, both external and internal; may be made, as well by Suction as by Emission of the Breath: as in Whistling or Breathing^p.

S E C T. X.

Of the Articulation of Sounds.

That Sounds are not only in the whole, but also in small parts of the Air.

1. **T**IS one of the greatest Mysteries in Sounds, that the whole Sound is not only in the whole Air; but the whole Sound is also in every small part of the Air: so that all the curious diversity of articulate Sounds, as in the Voice of a Man or Birds, will enter at a small Chink, without Confusion.

That unequal Agitation does not confound the Articulation of Sounds.

2. The unequal Agitation of the Winds, or the like, tho it promotes the Conveyance of Sounds; yet does not confound their Articulation, within the Distance they can be heard to: tho it may cause them to be heard the less way^q.

Great Distance confounds Sounds.

3. Too great Distance confounds the Articulation of Sounds: thus we may hear the Sound of a Preacher's Voice, when we cannot distinguish what he says. And one articulate Sound will confound another; as when many speak at once.

That Loudness and Lowness in Excess confounds Articulation.

4. In speaking under Water, when the Voice is reduced to an extreme Exility^r; yet the articulate Sounds, that is the Words, are not confounded. I conceive, that an extreme small, or an extreme great Sound, cannot be articulate; but that Articulation requires a mediocrity of Sound: as the extreme small Sound confounds the Articulation by contracting; and the large one by dispersing. And tho an articulate Sound already created, will be contracted into a small Compass, and pass thro' a narrow Chink; yet the first Articulation requires a greater Dimension.

Vaulting above and below hinders Articulation.

5. It has been observed, that in a Room, or Chappel, vaulted below and above, a Preacher cannot be heard so well, as in the like places, not so vaulted. For in this Case the subsequent words come on, before the precedent ones vanish: and therefore the articulate Sounds are more confused, tho the gross of the Sound be greater.

6. The

^p This Article remains considerably defective.

^q See Mr. Derham's Latin Paper upon the *Motion of Sounds*, in the *Philosophical Transactions*, N^o 313.

^r See above, *SECT.* III. 10.

6. The Motions of the Tongue, Lips, Throat, Palate, &c. which go to make the several *Alphabetical Letters*, relate to the *Enquiry of Sounds*. The *Hebrews* have been diligent herein : and determined which Letters are labial, dental, guttural, &c. The *Latins* and *Grecians* have distinguish'd between *Semi-Vowels* and *Mutes* ; and in *Mutes* tolerably well between *mutæ tenues*, *mediæ* & *aspiratæ* : tho not with Diligence. For, they have little examined the particular Percussions and Motions that create those Sounds : as that the Letters, B, P, F, M, are not expressed, but with contracting or shutting the Mouth ; that the Letters N and B, cannot be pronounced together, without the Letter N turning into M : As *Hecatonba* will become *Hecatomba* : That M and T cannot be pronounced together, but P will come between them ; as *Emtus* is pronounced *Emptus* : and there are many of the like Instances. So that whoever enquires to the full, will find, there are fewer simple Motions required, to the making of the whole Alphabet, than there are Letters †.

The Motions of the Organs of Speech in expressing the Letters.

7. The *Lungs* are the most spongy Part of the Body, and therefore able to contract and dilate ; and when they contract, they expel the Air ; which passing thro' the *Aspera Arteria*, Throat, and Mouth, makes the Voice : but Articulation is not produced without the help of the Tongue, the Palate, and the rest of those call'd the Organs of Speech.

The Voice and Articulation, how form'd.

8. There is a Similitude between the Sound made by inanimate Bodies, or animate Bodies that have no articulate Voice ; and several Letters of articulate Voices : and Men have commonly given such Names to these Sounds, as allude to the articulate Letters. Thus the trembling Sound of Water bears a resemblance to the Letter L ; the quenching of hot Metals, in Water, to the Letter Z ; the snarling of Dogs, to the Letter R ; the Voice of Screech-Owls, to the Letters *Sh* ; the Voice of Cats, to the Diphthong *Eu* ; the Voice of Cuckows, to the Diphthong *Ou* ; the Sounds of Strings, to the Letters *Ng*. So that for Instance, to make an inanimate Body pronounce a word ; the Motion of the Instruments of the Voice must be consider'd, on the one side ; and the like Sounds made in inanimate Bodies, on the other ; and what Conformity causes the Similitude of Sounds †.

Intimations for making inanimate Things speak.

D d 2

S E C T.

† This is a curious Part of the *Enquiry*, and of large Extent ; which some make a part of *Grammar* or *Speech* : tho it requires a *Physical Consideration*. Let Dr. Holder, Dr. Wallis, M. Amman, the *Philosophical Transactions*, and the *French Memoirs*, be consulted upon this occasion.

† Were it not hence easy to make a *Dog*, a *Cat*, or other Creature pronounce certain Words distinctly ? And is there any other Secret in the accounts we have had of *Speaking Dogs*, than that the Master knew how to make them *growl*, or *howl* in one continued Tone, whilst he modulated the Sound with his Hand, by directing the Motion of the Dog's Mouth, so as to render the Voice articulate ? And if this general *Enquiry* were to be duly prosecuted, no doubt, but even inanimate Bodies, however strange it may seem, might be made to speak certain Words. And whoever shal thoroughly understand the Nature of Sounds, will be able to do much greater Things than these. For such Things only appear strange thro' our own Ignorance.

S E C T. XI.

Of the Direction of Sounds.

That Sounds move every way, and not necessarily in a strait Line.

1. SOUNDS move in a Sphere ; that is, every way ; upwards, downwards, forwards and backwards ; as appears in all Instances. Sounds do not, like the Rays of Light, require to be convey'd to the Sense in right Lines ; tho they move strongest in a right Line : because such a Line is the shortest Distance. Hence, a Voice on one side of a Wall is heard on the other : not because the Sound passes thro' the Wall ; but Arch-wise over it.

Sounds when stopp'd go round.

2. If a Sound be stopp'd, and repell'd, it goes round on the other side ; in an oblique Line. Thus, if a Bell be rung on the North side of a Chamber, and the Window of that Chamber open to the South ; a Person within the Chamber would think the Sound came from the South : and the Case is the same in a Coach, &c.

Sounds go farthest in the front Lines to the sounding Body.

3. Sounds, tho they move in a Sphere, yet are strongest, and go farthest in the Front-Lines, from the first impulse of the Air : and therefore, in preaching, the Voice is better heard before the Pulpit, than behind it, or on the sides ; tho it stand open. So a piece of Ordnance will be farther heard forward from the mouth of the Piece, than behind, or on the sides.

Whether Sounds move better downwards or upwards.

4. It may be suspected, that Sounds move better downwards than upwards. Pulpits are placed high above the People : and when the ancient Generals harangued their Armies, they had always a Mount cast up, for them to stand upon. But this may be imputed to the Stops and Obstacles, which the Voice meets with, in speaking on a Level. Yet there seems to be somewhat more in it ; for perhaps *spiritual Species*, both visible and audible, move better downwards than upwards. 'Tis strange, that to Men standing upon the Ground, others on the top of St. Paul's, seem not only much less, but cannot be known ; whilst to those above, the Persons below seem not so little, and may be known ; tho all other Things to them above, seem somewhat contracted, and better defined, or collected into Figures. So Knots in Gardens shew best from an upper Window or Terras. But to make an exact Trial, with regard to Sound, let a Man stand in a Chamber not much above the Ground ; and speak out at the Window thro' a Trunk, as softly as he can, to one standing on the Ground ; the other laying his

^v See Mr. Derham's *Experiments*, in the *Philosophical Transactions*.

^v This may hold true of Sounds, because of the greater Density of the Air below than above : but will it hold true of Vision, for the same Reason ?

^w Is the Observation verified ?

^x Why should not the Experiment be tried at a greater height from the Ground ; if a long Tube were procurable ? What is the common Observation of Masons, working on the top of a Steeple, and conversing with others below ?

his Ear close to the Trunk : then let the Person below speak, in the same degree of Softness ; and let him in the Chamber lay his Ear to the Trunk : and this may be a proper means to judge whether Sounds descend or ascend the better.

S E C T. XII.

Of the Duration of Sounds ; and the time they require in their Generation, or Propagation.

1. **A**FTER Sound is created, as it is in a moment, we find it continues some small time, melting by degrees. And here a great Error has prevailed, in taking this to be a continuance of the first Sound ; whereas it is a Renovation : For the Body struck has a Trepidation wrought in the minute Parts ; and so renews the Percussion of the Air. This is evident ; because the melting Sound of a Bell, or String, ceases as soon as the Bell or String is touch'd. And here are two Trepidations to be distinguished : the one manifest and local ; as of the Bell when it is pensile : the other secret, and of the minute Parts¹ : yet the local greatly helps the secret one. So likewise in Pipes, and other Wind-Instruments, the Sound lasts no longer than the Breath blows. 'Tis true, that in Organs there is a confused Murmur for a small time after ; but this is only while the Bellows are falling.

The Continuance and melting of Sounds, whence.

2. 'Tis certain, that the Report of Ordnance, where many are fired together, will be carried above twenty Miles by Land ; and much farther by Water : but then it comes to the Ear, not in the instant of shooting ; but perhaps an Hour or more after² : which must needs be a continuance of the first Sound : for there is no Trepidation to renew it. And the touching of the Ordnance wou'd not extinguish the Sound the sooner : so that in greater Sounds, the continuance is more than momentary.

The Motion of Sounds.

3. To try exactly the time wherein Sound is propagated ; let a Man stand in a Steeple, with a Taper, veiled ; and let another Man stand a Mile off : then let the Person in the Steeple strike a Bell ; and at the same Instant withdraw the Veil or Blind, that the other at a Distance may measure the Time between the Light seen, and the Sound heard : for Light is propagated instantaneously³. This may be tried in far greater Distances ; allowing greater Lights and Sounds.

An Experiment for determining the Velocity of Sound.

4. 'Tis

¹ This Distinction is made great Use of by M. Perault, in his *Essais du Bruit*.

² The Velocity of Sound is somewhat differently computed by different Authors. According to Mr. Boyle it moves 1200 English Feet in a Second ; and according to Dr. Halley 1142. See *Newton. Princip. Lib. II. Prop. 50*. And again, Mr. Derham's Paper in the *Philosophical Transactions*, N^o 313.

³ Or what comes very near thereto : for in the space of seven or eight Minutes, it is thought by some to travel from the Sun to the Earth. See *Newton. Princip. Lib. II. Prop. 96. Schol.*

*That Sound
moves slower
than Light.*

4. 'Tis generally observed, that Light moves swifter than Sound; for the flash of a Musket is seen sooner than the Report is heard. And in the hewing of Wood, we may see at some Distance, the Arm lifted up for a second Stroak, before we hear the Sound of the first. And the greater the Distance, the greater is the Anticipation: as in Thunder afar off; when the Lightning long precedes the Crack ^b.

*The difference
betwixt
Sounds and
Colours as to
melting away.*

5. Colours represented to the Eye, neither fade, nor melt by degrees; but appear still in the same strength; whilst Sounds melt and vanish by little and little: for Colours participate not of the Motion of the Air; as Sounds do. And 'tis manifest that Sound participates of some local Motion of the Air; because it perishes so suddenly: for in every Division or Impulse of the Air, the Air suddenly restores and re-unites itself; which Water also does, tho not so swiftly.

S E C T. XIII.

Of the Passage and Interception of Sounds:

*Cautions re-
quired in ma-
king Experi-
ments about
the Passage of
Sounds.*

1. **I**N Experiments of the Passage, or Resistance of Sounds, care must be had not to mistake the passing along the Sides of a Body, for the passing thro' a Body: and therefore the intercepting Body should be very close; for Sound will pass thro' a small Chink. But when the Sound is to pass thro' a hard or close Body; as a Wall, Metal, Water, &c. the Body must be but thin and small; otherwise it utterly damps the Sound: whence in the Experiment of speaking under Water, the Voice must not be very deep within the Water; for then the Sound would not penetrate thro'.

*That the
pneumatical
Parts of
sounding Bo-
dies co-operate
most when the
sides are struck.*

2. 'Tis certain, that in the passage of Sounds thro' hard Bodies, the Spirit or pneumatical part of the Body itself, co-operates ^c; but much better when the Sides of the hard Body are struck, than when the Percussion is only internal, without touching the Sides. Take, therefore, a Hawk's Bell, with the Holes stopped up; and hang it, by a Wire, within a Glass Bottle; close the mouth of the Glass with Wax; then shake the Glass, and try whether the Bell will give any Sound, or how weak ^d.

*Sounds differ-
ently damped
by different
Arches.*

3. 'Tis certain, that a very wide Arch descending sharp, will quite extinguish Sounds; so that the Sound which would be heard over a Wall, cannot be heard over a Church; nor the Sound, audible at some Distance from a Wall, be heard close under the Wall.

4. Soft

^b On this Foundation the Distance of Explosions, Thunder, &c. may be readily known; by counting the Seconds that pass betwixt the Flash and the Report. See the Note to § 2. above.

^c This is more fully insisted upon above, *Seet. III. 8.*

^d The Invention of the *Air-Pump* and *Condenser* has render'd numerous Experiments, with Relation to *Sounds* and *Hearing*, much more commodiously practicable, than they could have been without it. But Philosophers seem weary of these new *Engines*, already; before half their Uses are known.

4. Soft and foraminous Bodies will deaden Sounds in their first Creation ; *Soft Bodies damp Sounds in their first Production.* for the striking against Cloth or Fur makes little Sound ; but in its Passage, they admit it better than harder Bodies : so Curtains and Hangings do not stop a Sound much ; but Glass Windows, if very close, will check it more than the like thickness of Cloth.

5. 'Tis worth enquiring, whether great Sounds do not become more weak and exile, in passing thro' small Chinks : for the subtilties of articulate Sounds may perhaps pass them unconfused ; but magnitude of Sound not so well ^e. *Whether large Sounds are damp'd by going thro' strait Passages.*

S E C T. XIV.

Of the Medium of Sounds.

1. **T**HE Mediums of Sounds are *Air, Water*, soft and porous Bodies ; *Air the best adapted Medium of Sound.* and in some degree also, hard ones : but all of them are dull and unapt, except the *Air*. The thinner Air does not convey Sound so well as the denser. This appears from Sounds in the Night and Evening ; in moist Weather, and in Southern Winds : for thin Air is better penetrated ; whilst a thick Air better preserves the Sound from waste. But let farther Trial be made, by hollowing in Mists and gentle Showers : for Dampness, perhaps, will somewhat deaden the Sound ^f.

2. How far Flame may be a Medium of Sounds ; especially such as are created by Air, and not betwixt hard Bodies ; may be tried by speaking where a Bonfire is between : but then allowance must be made for some disturbance in the Sound, caused by that of the Flame itself. *Whether Flame be a Medium of Sound.*

3. Whether any other Fluids, being used as Mediums, propagate Sound differently from Water, may be easily tried ; as by striking the bottom of a Vessel, fill'd either with Milk, or Oil ; which, tho more light, are more unequal Bodies than Water ^g. *Whether other Fluids propagate Sounds differently from Water.*

S E C T. XV.

Of the Figures of the Concaves, or Bodies, thro' which Sounds are convey'd.

1. **T**HE Figure of a Bell partakes of the inverted, truncate Pyramid ; but comes off and dilates more suddenly. The Figure of the Huntsman's Horn, and Cornet, is oblique ; tho there are likewise strait Horns ; which if of the same Bore with the crooked ones, differ little in Sound ; tho

^e See *Self*. X. 4, 5.

^f See Mr. Boyle's *Pneumatical Experiments* relating to Sounds.

^g This Article also remains but imperfectly prosecuted.

tho the strait ones require a somewhat stronger Blast. The Figures of *Recorders*, and *Pipes*, are strait ; but the Recorder has a less Bore above ; and a greater below. The Trumpet has the Figure of the Letter S^b, which makes the purling Sound, &c. Generally the strait Line makes the clearest and roundest Sound ; and the crooked the more hoarse and jarring.

Trials of differently figured Bores recommended.

2. Trial should be made with a sinuous Pipe, having four Flexures : as also with a Pipe made in the form of a Cross, and open in the middle ; and again with an angular Pipe : to see what would be the Effects of their several Sounds. Try likewise a circular Pipe ; made perfectly round, with a Hole to blow in ; and another not far from that ; but with a Transverse, or Stop between them ; so that the Breath may go the round of the Circle, and issue at the second Hole ⁱ.

Differently figured Solids.

3. Percussions may be likewise tried in solid Bodies of several Figures ; as Globes, Flats, Cubes, Crosses, Triangles, &c. and their Combinations ; as Flat against Flat, Convex against Convex, Convex against Flat, &c. to shew the diversities of the Sounds they produce. Try also the difference of Sounds in several Thicknesses of hard Bodies, when struck. I have tried, that a Bell of Gold yields an excellent Sound ; not inferior to one of Silver or Brass, but rather better ^k : yet a piece of Gold Coin, sounds much flatter than a piece of Silver.

4. The Harp has its Concave running cross-wise to the Strings ; and no Instrument yields so melting and prolong'd a Sound as the *Irish-Harp*^l. So that if a Virginal were made with a double Concave ; the one all the Length, as the Virginal has ; the other at the end of the Strings, as the *Harp* has ; it might make the Sound more perfect, or not so shallow and jarring. It may be tried without any Sound-board along ; but only Harp-wise at one end of the Strings : or lastly, with a double Concave ; one at each end, of the Strings ^m.

S E C T. XVI.

Of the Mixture of Sounds.

1. **T**H E R E is an apparent diversity between visible and audible Species, in this ; that the visible do not mix in the Medium ; but the audible do : for we can see a number of Trees, Hills, Men and Beasts, at

^b Some Trumpets have a *Circular Turn* in the middle.

ⁱ Is not this the Structure of the little round *Horn* or *Pipe* used by the *Postillions* in *Germany* ; which gives a very odd Sound, not to be described by Words ; being a kind of mixture of Shrillness, Loudness, and Stops, somewhat resembling the Braying of an Ass ?

^k Was the *Gold* pure, or alloy'd ? One would not expect that so soft a Metal as pure Gold, should ring clear and strong.

^l Observe, that the *Irish Harp* has metalline Strings ; and is play'd with the Nails ; not the Ends of the Fingers ; as the *Welch Harp* is, the Strings whereof are Gut.

^m What is the new Contrivance practised in *upright Harpsicords* ? These Experiments are of the same kind with those recommended above, *Seet. VIII.* and regard the Improvement of *Musical Instruments*.

at once ; without the one confounding the other : but if so many Sounds came from several Parts, they would utterly confound each other. Thus Voices, or Concerts of Musick make Harmony by Mixture^a, which Colours do not. 'Tis true, indeed, that a great Light drowns a smaller ; as the Sun does that of a Glow-worm ; and a great Sound drowns a less. So likewise, if there were two Glass Lanthorns, the one of a Crimson Colour, the other of an Azure, and a Candle were included in each ; I suppose these colour'd Lights would mix and cast a Purple Colour upon white Paper^o. And even Colours yield a faint and weak Mixture ; for white Walls make Rooms more lightsome than black. But the Confusion in Sounds, and the Distinctness of visible Objects proceeds from hence, that the Vision is made in right Lines, by means of several distinct Cones of Rays ; whence there can be no Coincidence in the Eye, or visual Point : whereas Sounds, that move in oblique and crooked Lines, must needs meet and disturb one another^p.

2. The sweetest and best Harmony is made, when every Part, or Instrument is not heard by itself, but a general Concert of them all ; which requires the Audience to be at some distance : after the same manner as the mixture of Perfumes is received ; or the Smells of several Flowers in the Air^q. The Disposition of the Air, as to other Qualities, unless joined with Sound, has no great effect upon Sounds : for whether the Air be light or dark, hot or cold, in silent Motion, or at Rest, sweet or fetid, &c. this can make only some petty Alteration : but Sounds disturb and alter one another ; sometimes by drowning, sometimes by jarring and discording, and sometimes by confounding with each other ; and sometimes the one mixes and compounds with the other, and makes Harmony^r.

What maketh the truest Harmony.

3. Two Voices of the same Loudness will not be heard twice as far as one of them alone ; and two Candles of equal Light, will not render Things visible, twice as far as one. The Cause lies deep ; but it should seem that the Impressions from the Objects of the Senses mix respectively, every one with its kind ; but not in proportion : the Reason may be, that the first Impression, which is from Privative to Active, as from Silence to Noise,

In what proportion to the Original, Sounds are propagated.

V O L. III.

E c

or

^a Is it not the Excellence of Concerts, and the Beauty, or Perfection of Harmony, to have the Sounds of different Instruments perfectly embodied as it were, or mixed together, like the different Colours of Light, so as to strike the Ear with one compound Sensation, as if it came from a single Instrument, like Light from the Sun ? And if so ; cou'd not ways be contrived, by some particular Structure of the Musick-Room, or *Opera House*, to incorporate these Sounds ; before they came to the Ears of the Audience ? And by a suitable Contrivance of this kind, might not a *Dutch* or an *English* Concert be render'd as agreeable as an *Italian* one ? See the next Paragraph below.

^o Sir *Isaac Newton* has many Particulars relating to this Subject, both in his *Opticks* and *Principia*.

^p See this Matter farther clear'd up by Sir *Isaac Newton*. *Princip. Lib. II. Prop. 50. Schol.*

^q This Comparison seems very well to explain the Nature of Concert. See the Note upon § 1. above.

^r Is this strictly and fully explained by Sir *Isaac Newton's* Doctrine of Sounds ; which makes them no more than propagated Pulses of the Air, proceeding from tremulous Bodies ? See *Princip. Lib. II. Prop. 50.*

or from Darkness to Light, is a greater degree, than from less Noise to more Noise, or from less Light to more Light. The Reason of this again may be, that the Air after it has received a Charge, does not receive a greater Charge, with the same Appetite, as at first. But to determine, the increase of Virtues, in proportion to the increase of Matter, is a large Field, that requires a particular Treatment ^f.

S E C T. XVII.

Of the Melioration of Sounds.

Sounds meliorated by Smoothness in the sounding Body.

1. **A**LL concurrent Reflexions make Sounds greater; but if the Body that gives the original Sound, or the Reflexion, be clean and smooth, it makes them sweeter. Trial may be made in a Lute or Viol, with the Belly of polish'd Brass, instead of Wood. We find even in the open Air, that the Wire String is sweeter than the Gut-string [†]. And for Reflexion, Water excels: as we find in Musick near a River; and in Echoes. It has been tried, that a Pipe a little moistned on the inside, yet so as to leave no Drops, makes a more solemn Sound, than if the Pipe were dry; yet with a sweet degree of Purling: for all porous Things, by being moist, or, as it were, in a state between dry and wet, become a little more even and smooth: but the Purling, which proceeds from Inequality, I take to be caused between the smoothness of the inward Surface of the Pipe, which is wet; and the rest of the Wood of the Pipe, to which the wet does not reach [‡].

By dry Weather, and long keeping of the Instrument.

2. Musick within Doors, sounds better in frosty Weather; perhaps not so much from the Disposition of the Air, as of the Wood or String of the Instrument; which is thus made more crisp, and thence more porous or hollow: and we find that old Lutes sound better than new ones, for the same Reason; so do Lute-strings that have been long kept [‡].

By the mixture of open Air with confined.

3. Sound is likewise meliorated by the mixing of open Air, with confined Air. Trial, therefore, may be made of a Lute, or Viol, with a double Belly; and another Belly with a Knot over the Strings; yet so as to leave scope enough for the Strings to play below that Belly. Trial may be likewise made

^f This is a Subject that seems properly to fall under Mathematical Consideration; after particular Experiments have been made. Something considerable is done in this way by Galileo, Sir William Petty, and others in a few Subjects: but the Design has by no means been extended to all sorts of *Virtues, Powers, and Effects*, as it deserves; particularly in *Odours, Eleftricks, Magneticks, Menstruums, &c.*

[†] This is not judged so by all Ears; tho possibly a Gut-string cannot be made so smooth and even as the Wire-string.

[‡] It may perhaps be a *contradictory Instance* to these, that the Sound of an *Ivory Hautboy* is not sweeter than one of *Wood*. And both in this, and all other Enquiries, the *contradictory Instances* should be sought with as much Diligence as the concurrent; if we desire to come at the *Forms of Things*.

[‡] It might deserve to be tried, whether *false Strings* becoming *true* by keeping, as they have been found to do, acquire an equal *thickness*, in their *Parts*, which they had not before.

made of an *Irish* Harp, with a Concave on both Sides: tho perhaps it might thus rebound too much; whereby one Note would overtake another. To Sing in the Hole of a Drum, makes the Voice sweeter. So I conceive it would, if a Song in Parts, were sung in at several Drums: and for Elegance sake, there might a Curtain be drawn between the Drums and the Audience.

4. The Sound created in a Wind-Instrument, between the Breath and the Air, is meliorated, by communicating with a more equal Body of the Pipe: for there would doubtless be a different Sound in a Trumpet or Pipe of Wood; from that of a Trumpet or Pipe of Brass. It were proper to try the Effects of Brass Recorders, and Brass Horns *.

By Equality in the Body of the Instrument.

5. Sounds are meliorated by the intension of the Sense, whilst the other Senses are collected to the particular Sense of Hearing, and the Sight suspended: whence Sounds are sweeter in the Night, than in the Day; and I suppose sweeter to blind Men than to others. And 'tis found, that between sleeping and waking, when all the Senses are bound, Musick is far sweeter, than when one is full awake *.

By the Intension of the Hearing, and a Suspension of the other Senses.

S E C T. XVIII.

Of the Imitation of Sounds.

1. **T**HIS strange, when attentively consider'd, how Children, and some Birds learn to imitate Speech. They take no Notice at all of the Motion of the Mouth; for Birds are as well taught in the Dark as by Light. The Sounds of Speech are very curious and exquisite: whence one would think it were a Lesson hard to learn. 'Tis true, it is conquer'd with Time, by Degrees, and with many Trials; but all this does not solve the Wonder. It would almost make one think there is some Transmission of Spirits; and that the Spirits of the Teacher put in Motion, work with the Spirits of the Learner, a pre-disposition to imitate; and so to perfect the Imitation by degrees †. And for Imitation, 'tis certain, there is in Men and other Creatures, a pre-disposition to imitate. How readily do Apes and Monkeys imitate all the Motions of Men? And in the catching of Dottrels, we see how the foolish Bird plays the Ape in Gestures; and no Man, in Effect associates with others, but he learns unawares some of their Gesture, Voice, or Manner.

Whence the Imitation of Sounds proceeds in living Creatures.

E e 2

2. In

* By what physical means is the Sound of a Violin made to resemble that of a Drum, a Hautboy, the French-Horn, the Bag-Pipe, the Organ, &c. as in a skilful Hand it does to great Exactness.

† All the other ways of meliorating Sounds should be here enumerated. Consider the use of Sound-Boards; and their best Figure; a proper one to place behind the Actors upon the Stage, that may meliorate the Voices, and convey them better to the Pit and Galleries, &c.

‡ See the Articles IMITATION and SYMPATHY.

*Birds imitate
Sounds without
being taught by
Man.*

*Only Birds imi-
tate human
Speech.*

*Whence the su-
perior aptness
of Birds for
imitating Voi-
ces.*

2. In the Imitation of Sounds, 'tis not necessary that Man should be the Teacher : for Birds will learn of one another ; without any Reward, as by feeding, or the like, given them in way of Encouragement. Besides, Parrots will not only imitate Voices, but Laughing, Knocking, the Squeaking of a Door, or a Cart-wheel ; and any other Noise they hear ^z.

3. No Brute can imitate the Speech of Man ; but only Birds : for the Ape, that is otherwise so ready to imitate, attains not to any degree of Speech ; tho there are Dogs, which if a Person howl in their Ear, will fall a howling, and continue it a great while. This aptness of Birds above Beasts, in imitating the human Speech, should be farther examined. Beasts have those Parts which are accounted the Organs of Speech, as Lips, Teeth, &c. more like to Men than Birds have : and for the Neck, many Beasts have it as long as Birds. What better Gorge or Apparatus Birds have, may be farther enquir'd. The Birds that are known to speak, are *Parrots*, *Pies*, *Jays*, *Daws*, and *Ravens* ^a : among which, *Parrots* have a hooked Bill, the rest not.

4. But perhaps this aptness of Birds lies not so much in the Conformity of the Organs of Speech, as in their Attention : for Speech must come by Hearing and Learning ; and Birds attend and mark Sounds more than Beasts ; because they are naturally more delighted with them, and practise them more ; as appears from their Singing ^b. Those who teach Birds to sing, keep them awake, to increase their Attention. And Cock Birds among singing Birds are always the better Singers ; perhaps, because they are more lively, and listen more.

5. Assiduity and Application in imitating Voices, conduces much to Imitation : whence there are certain Mimicks who will represent the Voices of Players and others to the Life. And there have been those who could counterfeit the Distance of Voices, so as that when they stand close by ; you would think the Speech came afar off. How this is done may be farther examined : tho I see no great Use of it but for Imposture ^c.

S E C T.

^z The Stories related of Parrots, are some of them very extraordinary ; but scarce any more remarkable than that insisted upon by Mr. *Locke*, in his *Essay upon Human Understanding* ; where the Parrot seem'd not only to speak distinctly, but to hold a Dialogue rationally ; and appositely imitated the Cluck of a Hen, in using the human Voice.

^a The foreign Speaking-Birds should be also enumerated.

^b It is an agreeable surprize to see with what Attention a *Canary Bird* will take a Lesson from the Flagelet ; and in Time be brought to sing an intricate *Italian Air* ; provided it be not too long. Tho the Bird is soon apt to forget it, unless his Memory be frequently refreshed by the Master.

^c Many Persons have seen a remarkable Instance of this kind in a certain Smith of *London*, who had an extraordinary Talent in making his Voice appear to come from any part of the Room, or House, where he was ; so as to work surprizing Effects upon those who were not let into the Secret : and thus, 'tis said, he once counterfeited a Man's Voice coming out of a large Cask, in a Cart loaded with empty Casks, as it was going along the Street ; to the great Astonishment and Perplexity of the *Carmak*.

S E C T. XIX.

Of the Reflexion of Sounds.

1. **T**HERE are three kinds of *Reflexion in Sounds*; viz. (1.) *Concurrent*; Three kinds of Reflexions in Sounds. (2.) *Iterant*, or *Echo*; and, (2.) *Super-reflexion*, or the Echo of an Echo. The Reflexion of visible Objects, by Mirrors, may be commanded; because, passing in right Lines, they may be directed to any Point: but the Reflexion of Sounds is hard to direct; because a Sound, filling larger Spaces in arched Lines^{*}, cannot be so guided: whence the Ways of making artificial Echoes have not been practised[†]. And no Echo, yet known, returns in a very narrow Space.

2. The natural Echoes are made by Walls, Woods, Rocks, Hills, and Banks. As for Water being near, it makes a concurrent, but farther off, an iterant Echo: for there is no difference between the concurrent Echo and the iterant, besides the quickness, or slowness of the Return. But Water, doubtless, helps the propagation of the Echo; as well as of original Sounds. The Doctrine of Echoes; viz. By what things they are made.

3. If a Person speak in a Trunk stopt at the farther end, the Blast returns upon the Mouth; but no Sound at all: for the closeness which preserves the Original, is not able to preserve the reflected Sound. Besides, Echoes are seldom created but by loud Sounds: whence there is less Hope of making artificial Echoes in Air, confined within a narrow Concave. Yet it has been tried, that by leaning over a Well twenty-five Fathom deep, and speaking, tho' but softly, the Water returned an audible Echo. It should also be tried, whether speaking in Caves, where there is no Issue, except at the Mouth, will not yield an Echo, as Wells do.

4. Echoes move as original Sounds do, in a Sphere of Air. It were proper to try the Production of Echoes, where the reflecting Body makes an Angle; as against the Return of a Wall, &c. In Mirrors, there is the like Angle of Incidence, from the Object to the Glass, as from the Glass to the Eye[‡]. And if a running Ball be struck side-way, the Rebound will be as much the contrary way: and whether there be any such Reflexion in Echoes, may be tried; that is, whether a Person will hear better, by standing on the side of the reflecting Body, than by standing where the Voice is; or any where, in a Right-line, between. Trial, likewise, should be made, Their Motion.
by

^{*} As being propagated Pulses of the *Atmosphere*, or *Medium*.

[†] Might not the making of artificial Echoes be now practised with Success? Surely, the many Discoveries every where allowed to be made in the *Business of Sounds*, since the Invention of the *Air-pump*, and the Improvements of Sir Isaac Newton, may enable us to produce more Effects than before: otherwise it is a Presumption, that these Discoveries are either not just, or not very significant; or else, that the modern Philosophers are very indolent.

[‡] It is an Axiom, in *Opticks*, that the *Angle of Incidence* is equal to the *Angle of Reflexion*, on all kinds of Surfaces.

by standing nearer the place of Reflexion, than the Speaker ; and again, by standing farther off ; to find whether Echoes, as well as original Sounds, be not strongest near hand ^a.

The Super-reflexion of Echoes.

5. In many Places may be heard a number of Echoes one after another : that is, when there is a variety of Hills, or Woods, some nearer, some farther off : so that the Return from the farther being last created, will be likewise last heard. As the Voice goes round the Person who speaks, so does the Echo ; for there are many Back-echoes, as well as Front ones.

To make an Echo repeat several Words distinctly.

6. To make an Echo report three, four, or five Words distinctly, 'tis requisite that the reflecting Body be at a good distance : for if it be near, yet not so near as to make a *concurrent Echo*, it chops with you of a sudden. 'Tis necessary, likewise, that the Air be not much confined ; for Air confined at a great distance, has the same Effect as Air at large, in a small distance. And therefore, in the Trial of speaking in the Well, tho the Well was deep, the Voice came back suddenly ; and would bear the Report but of two Words.

The Echo at Pont-Charenton.

7. With regard to Echoes upon Echoes, there is a curious Instance thereof, about three or four Miles from *Paris*, near a Town called *Pont-Charenton* ; upon the River *Sein*. The Room is a Chapel, with the Walls all standing, both at the Sides and at the Ends ; and two Rows of Pillars, after the manner of Isles : the Roof is open, and no Arch-work remaining near any of the Walls. There was, against every Pillar, a Stack of Billets, piled above a Man's height ; which the Watermen, that bring Wood down the *Sein* in Sacks, laid there for their Convenience. Speaking at the one End, it returned the Voice thirteen several times ; and, I was told, that it would return it sixteen times : for I was there about three of the Clock in the Afternoon ; and it is best, as all Echoes are, in the Evening. 'Tis manifest, this is not different Echoes from several Places ; but a tossing of the Voice, as a Ball, different ways : like Reflections in Looking-glasses ; where, if you place one Glas before, and another behind, you shall see the Glas behind, and the Image within the Glas before ; and again, the Glas before, in that ; and many such Super-reflexions, till the Images of the Object fail, and die at last : being in every Return weaker and more shadowy. So the Voice in that Chapel, makes succeeding Super-reflexions ; melting by degrees ; and every Reflexion growing weaker than the former. Thus, if you speak three Words, it will, for three times, perhaps, report the whole three Words ; then the two latter Words, for a few times ; and then the last Word alone, a few times ; still fading, and growing weaker. And whereas, in Echoes of one Return, it is extraordinary, to hear four or five Words ; in this Echo of so many Returns, you hear above twenty Words for three. The like Echo upon Echo, but only with two Reports, has been observed by standing between a House and a Hill, and hollowing towards the Hill ; for the House will give a Back-echo ; which may be mistaken for the other, tho the latter be the weaker.

8. There

^a The making of these Trials would, doubtless, discover some considerable Secrets for the Improvement of *Phonicks*.

8. There are certain Letters which an Echo can hardly express ; as S, for instance ; especially when a principal Letter in a Word. Thus, when I went to hear the Echo at *Pont-Charenton*, there was an old *Parisian*, who took it to be the Work of good Spirits ; for, said he, call out *Satan*, and the Echo will not deliver back the Devil's Name ; but cries, *Va tén*, which, in *French*, is, *begone* : and thereby I found that an Echo would not return S ; as being but a hissing, and interior Sound.

There are certain Letters inexpressible by Echoes.

9. Some Echoes are sudden, and chop again, as soon as the Voice is delivered ; others are more deliberate, or take more time between the Voice and the Echo ; which is caused by the Nearness, or Distance : some will report a longer train of Words, and some a shorter ; some as loud as the Original, or, sometimes, louder ; and others weaker and fainter. Where Echoes come from several Parts at the same distance, they must make, as it were, a Choir of Echoes ; and so increase the Report, and give a continued Echo ; as we find in some Hills that stand in compass like a Theatre ^b.

The Difference of Echoes.

10. It does not yet appear, that there is any *Refraction* in Sounds, as in Vision : for, I do not think, if a Sound should pass through different Mediums ; as Air, Cloth, Wood, &c. it would deliver the Sound in a different Place from that where it tends : which is the proper effect of Refraction ^c.

Whether there be a Refraction in Sounds ?

S E C T. XX.

Of the Relation and Difference between Light and Sound.

1. **B**OTH visible and audible Species diffuse themselves in a Sphere ; and fill the whole thereof, to certain Limits ; being carried to great Lengths ; but languish, and lessen by degrees, according to the distance of the Objects from the Sensories. (2.) The whole Species of both, are in every small portion of the Air, or Medium ; so that they pass through small Chinks, without confusion ; as appears from Levels, to the Eye, and from Slits, to the Ears. (3.) Both of them are suddenly and easily generated and

The Particulars wherein Sound and Sight agree.

^b Is not here a Foundation for some considerable Improvement in the Business of Sounds ; especially with relation to *Musick*, and *Concerts* ?

^c Are not all the common Sounds, in a certain Sense, refracted ? for they all move thro' a very unequal and mixed Medium, the Atmosphere, compounded of Water, Air, Salts, and Millions of other Matters ; so that it should seem we have never yet heard any, pure, direct, or unrefracted Sound ; which, perhaps, requires, a pure elastical Medium, such as pure and perfect Air. And if such a Medium of Sounds could be procured, what would be the Effect of our common Instruments play'd in it ? What the Effect of such a pure Medium condensed to a certain degree ? &c. Sir *Isaac Newton's* Doctrine of Sounds might, probably, be of some service in this Enquiry ; were it but more understood, or adapted to the Capacities of Artificers ; who, at present, are rather confounded than instructed by it. The Bishop of *Ferns* and *Leighlin*, has some useful, and plainer Intimations, relating to this Subject of *refracted Sounds* ; or, as he terms it, *Cataphonicks*, or *Catacousticks*. See *Philosophical Transactions*, Num. 156.

and propagated; and likewise perish swiftly and suddenly; as upon removal of the Light, or touching the sounding Body. (4.) Both of them receive and carry exquisite and accurate Differences; as of Colours, Figures, Motions, Distances, in Visibles; and of articulate Voices, Tones, Songs, Quavers, &c. in Audibles. (5.) Both of them in their Virtue and Operation appear to emit no corporeal Substance into their Mediums, or the Sphere of their Activity; nor to cause any evident local Motion in their Mediums, as they pass: but only to carry *certain spiritual Forms*; the perfect Knowledge of the *Cause* whereof is hitherto scarcely attained^d. (6.) Both of them seem not to generate or produce, any other Effect in Nature, but such as appertains to their proper Objects and Senses; and are otherwise barren. But both of them, in their own proper Action, have three manifest Effects: the *first* is, that the stronger Species drown the lesser; as the Sun drowns the Light of the Stars; and the Report of Ordnance, the Voice. The *second*, that an Object of Surcharge, or Excess, destroys the Sense; as the Light of the Sun, the Eye; and a violent Sound, the Hearing. The *third* is, that both of them may be reverberated; as in Mirrors, and Echoes. (7.) Neither of them destroys, or hinders the Species of the other, tho they meet in the same Medium; as Light, or Colour, does not hinder Sound; and *vice versa*. (8.) Both of them affect the Sense in living Creatures; and yield Objects of pleasure and dislike: tho these Objects also affect, and operate upon inanimate Things; *viz.* such as have some conformity with the Organs of the two Senses: thus the visible Species operate upon a Lens, which is like the Pupil of the Eye; and the Audible upon Places of Echo, which, in some sort, resemble the Cavern and Structure of the Ear^e. (9.) Both of them operate variously, according to the Disposition of the Medium: thus, a trembling Medium, as Smoke, makes the Object appear to tremble; and a rising or falling Medium, as the Air disturbed by Winds, makes the Sounds therein to rise or fall. (10.) The Medium most favourable to both, is *Air*; whereto Glass, Water, &c. are not comparable. (11.) In both of them, where the Object is fine and accurate, it greatly conduces to have the Sense intent and erect: thus we contract the Eye when we would see sharply; and erect the Ear when we would hear attentively; which, in Beasts, that have moveable Ears, is more manifest^f. (12.) The Rays of Light, when multiplied and condensed, generate Heat; which is a different Action from the Action of Sight: and the Multiplication and Condensation of Sounds generates an extreme Rarefaction

^d If this *Cause* be meant of the manner wherein the Sensations in Vision and Hearing are performed, it still remains unknown: tho the *physical* or *remote Causes* of both are thought, at this time, to be very well understood. And these *Causes* are sufficient for the Production of *great Effects*: so that it might soon be shewn, by endeavouring to produce *such Effects*, whether we are acquainted with these *Causes*, or not.

^e This will not appear strange, if it be remembered that *Action* and *Re-action* are equal.

^f Do not Animals, when they would hear distinctly, turn their Ear, in a particular manner, to the Place from whence they suspect the Sound proceeds? and what precise *Angle of Inclination* is this?

Rarefaction of the Air ; which is a material Action, differing from the Action of Sound ; if it be true that Birds, in their Flight, have been made to fall down by great Shouts ^a.

2. (1.) Visible Species seem to be Emissions of the Rays of Light from the visible Object, almost in the manner of Odours ^b, only that they are more incorporeal ; but *audible Species* seem to participate more of local Motion, like Percussions or Impressions made upon the Air ^c. So that, as all Bodies appear to operate two Ways, *viz.* either by the Communication of their Natures, or by the Impressions and Signatures of their Motions ; the Diffusion of *visible Species* seems to partake more of the former, and *audible Species* of the latter. (2.) The *Species of Audibles* seem to be more manifestly carried through the Air than the Species of Visibles : as a contrary strong Wind, will not much hinder the Sight, tho it does the Hearing. (3.) One Difference betwixt visible and audible Species, is, above all others, very remarkable ; as that whereon many smaller Differences depend ; *viz. Visibles* are carried in Right-lines, and *Audibles* in Curves. Whence it is, that Visibles do not intermix and confound one another, as Sounds do. And hence the Solidity of Bodies does not much hinder the Sight, provided the Bodies be clear, and the Pores in a Right-line ; as in Glafs, Crystal, Diamonds, Water, &c. but a thin Scarf or Handkerchief, tho Bodies nothing so near solid, hinder Vision ; whilst such porous Bodies do not much hinder the Hearing ; which solid Bodies almost stop, or, at the least, weaken. Hence also, small Glasses suffice for the Reflexion of Visibles ; but greater Spaces are required to the Reverberation of Audibles. (4.) Visible Objects are seen farther than Sounds are heard ; that is, in proportion to their Magnitude : for, otherwise, a great Sound is heard farther than a small Body can be seen. (5.) Visibles generally require some distance between the Object and the Eye ; but in Audibles, the nearer the Sound is to the Sensory, the stronger it proves. But in this, there may be a double Error ; the one, because Vision depends upon Light ; and any thing that touches the Pupil of the Eye all over, excludes the Light. For I had it from a very credible Person, who was himself cured of a *Cataract* ; that while the Silver Needle removed the Film of the *Cataract*, he never saw any thing more clear, or perfect, than that white Needle : no doubt, because the Needle was less than the Pupil of the Eye, and so eclipsed not the Light from it ^d.

The Particulars wherein they differ.

V O L. III.

F f

The

^a This last Particular requires a further Examination ; for there seem to be, hitherto, no certain Instances produced, to shew, that mere Sound, without *Heat, Flame, or Explosion*, does cause a Rarefaction of the Air. See *Sec. II. 3.* and consult Sir *Isaac Newton's* Doctrine of Sounds, *Princip. Lib. II.*

^b The Comparison holds true in *lucid*, but not in *illuminated* Bodies ; lucid Bodies being seen by means of their own Light, but *illuminated Bodies* by a borrowed one : whereas Odours seem to proceed only from the odoriferous Bodies themselves ; unless there be any scentless Bodies that reflect borrowed Odours.

^c Are not these the same that Sir *Isaac Newton* calls *Pulses*.

^d Does Sir *Isaac Newton's* Theory of Vision, by Pressure, reach this Case ? or, is the Fact well confirmed ? or is there not still some Deficiency in our Knowledge of the *Causes* of Vision : especially in particular *Disorders of the Eyes* ? which seem very little understood ; as may appear from the empirical Practices of *Oculists*.

The other Error may be, because the Object of Sight strikes upon the Pupil of the Eye directly, without any Interception; whereas the Cavity of the Ear keeps off the Sound a little from the Organ: so that there is some Distance required in both. (5.) *Visibles* are sooner carried to the Sense than *Audibles*; as appears in Thunder and Lightning; the Flash and Report of a Gun, &c. I conceive also, that the *Species of Audibles* hang longer in the Air than those of *Visibles*: for altho, even Visible Species hang some time, as when Rings are twirled round, they shew like Spheres; and a Fire-brand, carried swiftly along, leaves a Train of Light behind it, &c. yet Sounds seem to remain much longer; because they are carried up and down with the Winds: and because the distance of the Time is great, betwixt the Flash of a Cannon seen, and its Report heard, twenty Miles off¹. (6.) There are no Objects found so odious and ungrateful to the Sense in *Visibles*, as in *Audibles*: for odious Sight rather displease, as they excite the Memory of odious things, than by the immediate Object itself. Whence such Sight, in Pictures, are not very disagreeable; but in *Audibles*, the filing of a Saw is so offensive as to set the Teeth on edge: and the Ear is presently shocked at harsh Discords in Musick. (7.) In *Visibles*, if you come suddenly out of great Light into the Dark, or out of the Dark into a glaring Light; the Eye is dazled for a time, and the Sight confused: but whether there is any such Effect after great Sounds, or after a deep Silence, should be enquired. 'Tis an old Tradition, that those who dwell near the Cataracts of the Nile, are deaf: but we find no such Effect in Engineers, Millers, and those that live upon Bridges. (7.) It seems that the Impression of Colour is so weak, as not to operate but by a Cone of direct Rays, or Right-lines; whereof the Basis is in the Object, and the vertical Point in the Eye; whence there is a Corradiation, and Conjunction of Beams: and these Beams, so sent forth, are not sufficient to produce the like borrowed, or secondary Beams, without Reflexion: for the Beams pass, and give little tincture to the Air adjacent; otherwise we should see Colours out of a Right-line. But tho this happens in Colours, it is not so in the Body of Light: for when there is a Skreen between the Candle and the Eye, yet the Light passes the Paper, for example, when a Person is writing by Candle-light; so that the Light is seen where the Body of the Flame is not seen; and where any Colour would not be seen, that was placed where the Body of the Flame is. I judge, that Sound is of this latter Nature; for when two Persons converse, with a Wall betwixt them, the Voice heard is not, perhaps, only the original Sound which passes in an Arch-line: but the Sound that passes above the Wall, in a Right-line, may produce the like Motion round about it, as the first did; tho weaker^m.

S E C T.

¹ See above, Sect. XII. 2, and 4.

^m This Comparison betwixt *Sight* and *Hearing*, might be carried to a much greater Length: as it stands here, 'tis little more than a Recapitulation of what is before delivered; only with a View to such a Comparison. They are compared, in some few Respects, by Sir Isaac Newton in his *Opticks* and *Principia*; and, in some others, by the learned Prelate so often mentioned already. But the Subject is by no means exhausted; or brought to afford the necessary AXIOMS FOR PRACTICE.

S E C T. XXI.

Of the Sympathy, or Antipathy, of Sounds with one another.

1. **A**L L *Concords* and *Discords* of Musick, may be aptly called the *Sympathies* and *Antipathies* of Sounds: so, in that Musick termed Broken, or Confort-musick; some Conforts of Instruments, are sweeter than others: a thing not hitherto sufficiently observed. Thus, the *Irish-harp* and the *Base-viol*, consort well; so do the Recorder and Stringed-instruments; Organs and the Voice, &c. but Virginals and the Lute; the *Welsh-harp* and *Irish-harp*; or the Voice and Pipes, alone; agree not so well. But for the MELIORATION OF MUSICK, with regard to exquisite Conforts, there is much Matter left for Trial and Enquiry^a.

What Instruments suit best in Confort.

2. 'Tis a common Observation, that if a *Lute*, or *Viol*, be laid upon its Back, with a small Straw upon one of the Strings; and another Lute, or Viol, be laid by it; and the Unison to the former String be struck in the latter; it will make that String move; as appears, both directly to the Eye, and by the Effect of making the Straw fall off. And the like happens if the *Diapason*, or Eighth to that String, be struck; either in the same Lute, or Viol, or in others lying by: but in none of these, is there any Report of Sound to be discovered, but only Motion. It has been advised, that a Viol should have a Set of Wire-strings below, as close to the Belly as a Lute, and then the Gut-strings mounted upon a Bridge, as in ordinary Viols; so that, by this Means, the upper Strings being struck, should make the lower resound by *Sympathy*, and thus meliorate the Musick. If this succeed, *Sympathy* will appear to operate as well by the Report of Sound as by Motion. But this Device I conceive of no Use: because the upper Strings, which are stopped in great variety, cannot maintain a *Diapason* with the lower, which are never stopped; but if it has any Advantage, it must be seen in Instruments that have no Stops; as Virginals and Harps: wherein trial may be made of two Rows of Strings, distant the one from the other.

An Experiment of Sympathy, recommended for the Melioration of Musick.

3. The Experiments of Sympathy may, perhaps, be transferred from stringed Instruments, to others; as, if there were two Bells in Unison in one Steeple, to try whether striking the one would move the other, more than if it were a different Cord: and so in Pipes, of equal Bore and Sound, to try whether a light Straw, or Feather, would move in the one Pipe, when the other is blown in Unison with it.

The Experiment transferred.

4. It seems both to the Ear and Eye, that the Instrument of Sense has a Similitude, or Sympathy with that which gives the Reflexion: thus the

That the Organs of Sense have an Affinity with those things that affect them.

F f 2

Pupil

^a And, perhaps, the *Italians* themselves, have not advanced Musick to half that degree of Perfection it is capable of receiving from philosophical Improvements, to be made by such as have a *Head* as well as a *Hand*.

Pupil of the Eye is like Cryſtal, Glaſs, or Water ; and the Ear, a ſinous Cavity, with a hard Bone, to ſtop and reverberate the Sound ; like the Places of Echo °.

S E C T. XXII.

Of the Means of Hindering, or Improving the Hearing.

Instances wherein the Hearing is obſcured and promoted.

1. **W**HEN a Man yawns, he cannot hear ſo well : the Membrane of the Ear being then extended ; ſo as rather to repel the Sound, than attract it. We hear better when we hold our Breath, than otherwiſe ; whence, in all Liſtning, Men hold their Breath : for, in all Expiration, the Motion is outwards ; and therefore rather drives away the Voice, than draws it in. Beſides, in all Labour, that requires Strength, we hold the Breath ; and liſtning after any Sound that is heard with difficulty, ſeems a kind of Labour.

An Inſtrument for Deafneſs.

2. Let it be tried, for a help to Hearing, to make an Inſtrument like a Funnel, the length of ſix Inches or more ; the narrow part whereof may fit the Hole of the Ear, and the broader end ſwell much larger, like a Bell^p. Let the narrow end of it be applied cloſe to the Ear ; and obſerve, whether a Sound will not be heard diſtinctly at a greater diſtance than without this Inſtrument. I have been told, that in *Spain* they uſe an Inſtrument, which applied to the Ear, helps thoſe that are thick of hearing.

That Sound paſſes thro' the Noſtrils, if the Mouth be ſhut.

3. Tho the Lips be ſhut cloſe, there is a Murmur yielded by the Roof of the Mouth ; as in dumb Men : but if the Noſtrils are likewiſe ſtopped, no ſuch Murmur can be made, unleſs in the Bottom of the Palate towards the Throat. Whence it appears, that a Sound in the Mouth, except ſuch as that juſt mentioned, paſſes from the Palate through the Noſtrils, if the Mouth be ſtopped.

S E C T. XXIII.

Of the ſpiritual and fine Nature of Sounds.

That Echoes argue the ſpiritual Nature of Sounds.

1. **T**HE Repercuffion of Sounds, which we call Echo, is a great Argument of their ſpiritual Nature ; for if it were corporeal, the Repercuffion ſhould be cauſed in the ſame manner, and by the like Inſtruments, as the original Sound : but we ſee what a number of exquisite Inſtruments

° Hence may be derived a capital Rule, not only for the making of new muſical Inſtruments, but alſo many other Engines and Inſtruments for helping, improving, and perfecting the Senſes. The Imitation of Nature, is the ſhorteſt and ſureſt Method for Practice ; but then Nature ought firſt to be well underſtood.

^p This is the Inſtrument now in common Uſe for the Deaf ; and might, doubtleſs, be conſiderably improved ; from a tolerable knowledge in *Phonicks*.

ments must concur in speaking : whereas there is no such things concerned in the returning of Words ; but only a plain Stop and Repercussion ⁹.

2. The requisite Differences of articulate Sounds carried along in the Air, *Sounds not Im-*
shew that they cannot be Signatures, or Impressions in the Air : for tho Seals *pressions*
make excellent Impressions ; and tho Sounds in their first Generation, may be conceived as impressed ; yet the Propagation and Continuance of them, without any new sealing, shews them not to be impressed ¹.

3. All Sounds are suddenly made, and suddenly perish ; but neither this, *Extraordinary*
nor the exquisite Differences of them, is so wonderful : because the Quaver- *Properties of*
ings and Warblings in Lutes and Pipes, are as quick ; and the Tongue, *Sound.*
tho but a gross Instrument, makes no fewer Motions in Speech than there are Letters in all the Words it utters. But that Sounds should be so speedily generated, and carried so far every way, in so short a time, is more surprizing. For example ; if a Man speak aloud in the middle of a Field, he may be heard a Furlong round him ; and that in articulate Sounds, entire, in every little Portion of the Air : and all this shall be done in less than a Minute.

4. The sudden Generation and Destruction of Sounds, must proceed *The sudden*
from hence ; either that the Air suffers some force by Sound, and then re- *Generation*
stores itself, as Water does ; or, that the Air readily imbibes the Sound as *and Destruction*
grateful ; but cannot maintain it : for the Air seems to have a secret Ap- *of Sounds,*
petite of receiving Sound at first ; but then other gross and more material *whence.*
Qualities presently suffocate it ; like Flame, which is suddenly generated, but instantly extinguished, by the Enmity of the Air, or other ambient Bodies ¹.

5. Sounds, in general, are divided into, (1.) Musical, and Immusical. *The Division*
(2.) Trebler, and Bass. (3.) Flat, and Sharp. (4.) Soft, and Loud. *of Sounds.*
(5.) External, and Internal. (6.) Clear, Harsh, and Purling. And, (7.) Articulate, and Inarticulate ¹.

6. We have taken some Pains in this Enquiry about Sound ; not only be- *Conclusion.*
cause it is a secret and incorporeal Quality in Nature ; but because we were willing, in our first Attempt towards a just *Natural and Experimental History*, to give

⁹ This is easily cleared up on the Supposition of aerial Pulses.

¹ This drives at a higher, more immediate, and spiritual Explanation of Sounds, than that of the Impulse of the Air, with which we seem to rest generally satisfied.

¹ Let Sir Isaac Newton be consulted upon this Head. See *Princip.* Lib. II. Prop. 50.

¹ This Enquiry is not so far finished as those of *Winds ; Life and Death, &c.* whence we find here no *Canons*, or *Axioms* deduced in form ; tho there are the Seeds of several, sown through the whole. And whoever is disposed to improve the *History of Phonicks*, which is still greatly deficient, might do well to work upon this Plan ; range the whole more exactly ; add the later Instances ; and draw out the *Axioms* according to the Directions of the *Novum Organum*, and the other more finished Examples of the Author, in the *History of Life and Death, &c.* Were a Man, with a tolerable Talent at Experiments, to proceed upon this Design, he might, doubtless, improve the Subject of *Acousticks* to a considerable Pitch ; especially if he became acquainted with the Particulars intimated on this Head by the Bishop of *Ferns and Leighlin ; Dr. Grandi ;* and the Experiments of Mr. *Derham ;* all of them to be found in the *Philosophical Transactions.* To which may be added, for the physical Part, Mr. *Boyle ;* and, for the mathematical, Sir *Isaac Newton.* There are also some useful Hints to this Purpose, in the Essay of Mr. *Whiston* and Mr. *Dutton*, for discovering the *Longitude at Sea.*

give an Example of a tolerably exact *Enquiry* ; intending to do the like in another *Article*, or two ^v : being desirous that Men should thoroughly perceive, what a severe and rigid thing every true *Enquiry* into Nature must necessarily be ; and hence, accustom themselves to enlarge their Minds by the *Light of Particulars*, to the ample Measure of the Universe ; and not contract the *Universe* to the narrow Measure of their own Minds ^u.

SPIRITS IN BODIES.

Two kinds of
Parts, in Bo-
dies.

ALL solid Bodies consist of two different Parts ; viz. *Pneumatical* and *Tangible*. The *pneumatical Substance* in some Bodies, is their native Spirit ; in others, plain *Air* enters ; as in Bodies dried by Heat, or Age : for when the *Native Spirit* goes out, and the Moisture with it, the *Air*, in time, gets into the Pores. And these Bodies are always more brittle ; because the native Spirit is more yielding and flexible than *Air*. The *native Spirits*, also, admit of great Diversity ; as being either hot, cold, active, dull, &c. whence most of the Virtues and Qualities of Bodies proceed ; but the *Air*, intermixed, is without any particular Virtues ; and makes things more insipid, and unactive ^w. See the *Articles* IMAGINATION, NATURE, and SYMPATHY.

SPONGES.

The Growth
and Nature of
Sponges.

Near the Bottom of the *Streights* are gathered great Quantities of *Sponges*, from the sides of Rocks ; being, as it were, a large kind of tough Moss. This is the more remarkable, because there are few vegetable Substances that grow deep in the Sea ; but these are sometimes gathered at the Depth of fifteen Fathom : and, when thrown on Shore, they seem of great Bulk ; but when squeezed together, may be carried in a very small compass ^x.

S P R I N G S.

A Way of ma-
king artificial
Springs.

It was reported by a sober Man, that an artificial Spring might be thus made. “ Find out a Shelving-ground, where there is a great quick Fall of Rain-water ; and here bury a Stone Trough of a considerable length, “ three

^v As that of *Imagination, Vegetables, Sympathy, &c.*

^u If farther Directions be wanted for the Conduct of Enquires, the Reader may find them in the second Part of the NOVUM ORGANUM,

^w The due Prosecution of this Enquiry has been already more than once recommended ; and is, possibly, of as great Consequence as any Enquiry in all Physicks : for if we trace Nature closely in her Operations, perhaps we shall find, that she uses the Mediation of these Spirits in all her latent Processes of Vegetation, Animalization, Mineralization, and the Production of numerous Changes in Bodies. But we would, by no means, anticipate the Enquiry ; only endeavour to revive it : for it seems to have languished of late. See Dr. Power's Digression upon Animal Spirits ; in his *Experimental Philosophy*, pag. 61. See also, Sir Isaac Newton's Doctrine of Comets, *Princip. Lib. III. pag. 473, &c.* and the Queries at the End of his *Opticks*.

^x The large Quantity of Surface in Sponge, with regard to its Bulk, and the great Quantity of Water it will readily attract and retain, fit it for some considerable Purposes in Physicks. Thus, in particular, it has been successfully applied for the making of Hygrometers. See Mr. Boyle's *Statistical Hygroscope*.

“ three or four Foot deep ; with one End upon the high, and the other
 “ upon the low Ground. Cover the Trough with Brakes to a good thick-
 “ nefs ; and throw Sand upon the top of the Brakes : and now, *says he*,
 “ after some Showers are fallen, the lower end of the Trough will run like
 “ a Spring of Water.” This would be no Wonder, while the Rain lasted ;
 but, he added, that it would continue long after the Rain was over : as if
 the Water multiplied itself upon the Air, by the help of the Coldness and
 Condensation of the Earth, and the Association of the first Water.
 See the *Article* TRANSMUTATION.

STAMMERING.

The *Cause of Stammering* is, perhaps, the *Refrigeration of the Tongue* ; *The Cause of*
 whence it becomes less apt to move : for Naturals generally stammer. But *Stammering*.
 if stammering Persons drink Wine moderately, they stammer less ; because
 Wine heats : and so 'tis common to stammer more in the first offer to
 speak, than in continuance ; because the Tongue is warmed by the Motion.
 In some also, this Defect may proceed from the *dryness of the Tongue* ;
 which likewise makes it less apt to move : for many stammering Persons are
 choleric ; Bile inducing a dryness in the Tongue.

SUGAR.

Sugar has abolished the use of Honey : so that we have lost the ancient *The ancient*
 Preparations of Honey, when it was more esteemed. It seems there was *Preparations of*
 formerly Tree-honey : and one of the Ancients relates, that in *Trebisond*, *Honey to be*
 there was Honey issuing from the Box-tree, which made Men mad. Again, *supplied by*
 in ancient time, there was a kind of Honey which, either of its own Nature, *those of Sugar*,
 or by Art, would grow as hard as Sugar ; and proved not so luscious as ours.
 They

There may be reason to question the Success of this *Experiment* ; but many improbable Ex-
 periments have succeeded, and many probable ones have failed : so fallible a thing is Reason-
 ing *à priori*. If it could be brought to bear, it might prove of considerable Use on many
 Occasions ; and afford an Intimation of the natural Origin of Springs.

The *Causes* here assigned are, perhaps, rather accidental, or concomitant, than effici-
 ent ; for Stammering may sometimes proceed from a particular Conformation of the Organs of
 the Voice ; and as well from a natural as acquired Ineptitude in them to the pronouncing of
 certain Letters. The Defect seems plainly catching by Imitation, as many have experienced ;
 and may be remedied also, by a contrary Practice : and, doubtless, the *Art of curing Stam-*
mering might be improved by proper Application. It seems a principal Rule, that the
 Stammerer accustom, or, as it were, break himself to a Habit of pronouncing slowly,
 and distinctly ; more frequently dwelling upon those Letters, or combinations of Letters, at
 which he is apt to stammer most.

The Ancients had their *Confections, Honeys, Honey-balsams*, and other Preparations with
 Honey ; after the same manner as we have our *Preserves, Syrups, Elsofaccharums*, &c. with
 Sugar.

Honey appears to be a vegetable Juice, that is barely collected by the Bee.

May not all Honey be converted to Sugar, by an easy *Encheiresis* ? Do not Honey,
Raisins, &c. candy with Age, so as to yield Grains of actual Sugar ? May not all the
 sweet Substance contained in Malt, be converted into Sugar, and Treacle ? Perhaps Sugar is
 not peculiar to the *Sugar Cane* ; but may be obtained from all the sweet Juices of Trees,
 Fruits, and Grain.

They had also a *Wine of Honey*; which they made by dissolving the Honey in a large Quantity of Water, and straining the Liquor: they afterwards boiled it to a Half, then poured it into earthen Vessels, and soon after put it into Vessels of Wood; and kept it for many Years. They have also, at this Day, in *Russia*, and the Northern Countries, *Mead-simple*; which, well made, is a wholesome Drink, and very clear. They make, likewise, in *Wales*, a *compound Mead*, with Herbs and Spices. To compensate what we have lost in Honey, 'tis pity but a SUGAR-MEAD WERE BROUGHT INTO USE *without any Mixture of Honey*^d: for, tho' it would not be so absterfive and opening as Mead; yet it might be more grateful to the Stomach, more lenitive, and proper in sharp Diseases: for *Sugar* in Beer and Ale, has good Effects in such cases^e. See the *Articles* PRESERVATION, and VEGETABLES.

SWEAT.

*The Nature
and Regula-
tion of Sweat-
ing.*

I. When a Person bathes in hot Water, there comes no *Sweat* on the Parts under Water; because *Sweat* is a kind of Colligation, made neither by an over-dry, nor an over-moist Heat: for Over-moisture somewhat extinguishes Heat, as even hot Water will quench Fire; and an over-dry Heat shuts up the Pores. Hence Men will sooner sweat when covered, before the Sun, or Fire, than if they stood naked: and earthen Bottles, filled with hot Water, provokes Sweat in Bed, better than hot Bricks. Again, hot Water causes an Evaporation from the Skin; so as to spend the Matter in those Parts under the Water, before it collects and issues in Sweat. Lastly, Sweat comes more plentifully, if the Heat be increased by degrees, than if it be greatest at first, or continued equal: for the Pores are better opened by a gentle Heat, than a more violent one; and, upon their opening, the Sweat issues more abundantly. Physicians, therefore, when they provoke Sweat in Bed, by Bottles filled with a Decoction of sudorifick Herbs, might do well to make two degrees of Heat in the Bottles; and apply the less heated first, and after half an Hour, the hotter^f.

2. *Sweat*

^d *Angelus Sala* shews the Method of making a kind of Wine with Sugar, in his *Saccharologia*: but he had not the perfect Way, which is extremely simple and easy. This Subject, surely, would have been better cultivated, if MADE WINES, as they are called, did not lie under some Disrepute: which, in part, proceeds from the unskilful and coarse manner wherein they are generally prepared; and, in part again, from the Industry of certain Persons, whose Interest it is to beget a Consumption of *foreign Wines*.

^e This is a Subject I have, myself, prosecuted with some diligence; and, perhaps, far enough to form an AXIOM or two upon it, that shall contain the Substance of several new Arts; or lead to the Improvement and Perfection of Brewing, Wine-making, Vinegar-making, Distilling, &c. The AXIOM here principally meant is this. *A Saccharine Substance, or real Sugar, is the Basis of all Malt-liquors, Wines, Vinegars, and inflammable Spirits.* This AXIOM is derived from a large, and, possibly, a competent number of particular Experiments, Instances, and Observations; after the *Inductive Method*: but they are too many to be here inserted. It may deserve a particular *Treatise*, to shew how all kinds of Wines, Spirits, and Vinegars, are procurable to great Advantage from mere Sugar and Water: A Doctrine that deserves to be recommended to the Sugar Colonies Abroad, or certain Fabricators at Home. See the *Article* WINE.

^f The Introduction of Bagnios has almost abolished the Method of Sweating by Bottles: however the Rule holds good of Bagnios also, where the Heat is a Mixture of a dry Heat and a moist one; and increased by degrees. See the *Article* BATHING.

2. *Sweat* is saline to the Taste ; because that part of the Nourishment which is fresh and sweet, turns into Blood and Flesh ; and the Sweat is only a part separated and thrown off. Raw Blood also has some saltiness, more than Flesh ; because the Assimilation into Flesh happens not without a small and subtil Excretion from the Blood ^g.

3. *Sweat* comes more plentifully upon the upper-parts of the Body, than the lower ; because the upper-parts are more replenished with Spirits : and the Spirits are what send out the Sweat. Besides, those Parts are less fleshy : and Sweat issues chiefly out of the Parts that are dry and thin of Flesh ; as the Forehead and Breast ^h.

4. Men sweat more in Sleep, than waking : yet sleep rather checks, than promotes other Evacuations ; as Rheums, Diarrhoeas, &c. because in Sleep the Heat and Spirits naturally move inwards, and there continue ; but when they are once collected within, the Heat becomes more violent, and thence expels the Sweat ⁱ.

5. *Cold Sweats* are often mortal, and always suspected ; as in great Frights, hysterick Disorders, &c. for such Sweats proceed from a Relaxation, or Desertion of the Spirits ; whereby the moisture of the Body, which Heat kept firm in the Parts, separates and flies off.

6. *Sweat* is hurtful in those Diseases that cannot be discharged by it ; and in that case, ought rather to be stopped ; as in Diseases of the Lungs, and Fluxes of the Belly : but in those Diseases that are expelled by Sweat, it relieves and proves serviceable ; as in Agues, pestilential Fevers, &c. for here Sweat is partly critical, and drives out the offending Matter ; but in the former Cases, it either proceeds from the labour of the Spirits, which shews them oppressed ; or from Motion of Consent ; when Nature, unable to expel the Disease where it is seated, moves to a general Expulsion over all the Body ^k.

V o L. III.

G g

S W E L-

^g Here is the Foundation of a noble Enquiry into the Business of Sanguification, Assimilation, and Excretion : a Subject hitherto not prosecuted suitably to its Merits, nor the Intimations given for it by the Author.

^h The *Miliary Glands* are, at present, made the principal *Organ of Sweat* ; which lie dispersed over the whole Surface of the Body, under the *Cutis* : and if these Glands are thicker set in some Parts than in others, as the *Forehead*, *Breast*, &c. and Sweat be most plentiful in these Parts, we have hence a nearer Approximation to the Cause.

ⁱ Observe here that kind of *Interpretation*, which applied to the human Body, is the principal Means of improving both *Physiology*, *Nosology*, and the whole Science of *Medicine*.

^k This Subject seems to have been very sparingly touched by *Physicians* ; tho, certainly, a thing of great Consequence in the Improvement of their Art. 'Tis true, *Sudorificks* are much in use ; and Sweating is much practised ; but a physical Knowledge of the Nature, Cause, and Effects of Sweat ; with the best Methods of raising, governing, and directing it, in the Cure of certain Diseases, appears to be still wanting ; tho, perhaps, our Author has here laid the Foundations for supplying it. But, we have frequent Occasion to observe, there are few who follow his Steps.

SWELLING.

*The Cause of
Tumefaction in
Bruises.*

It has been observed, that Plates of Metal, and especially of Brass, presently applied to a Contusion, will keep down the Swelling ^m. The Cause is Repercussion, without Humection, or entrance of a Body: for the Plate has only a virtual Cold; which does not search into the Hurt, as all Plaisters and Ointments do. The Reason why Blows and Bruises produce Swelling, is, because the Spirits resorting to assist the Part, draw the Humours along with them; for it is not the re-action, or return of the Humour into the Parts upon the Blow, that causes it; since the Gout and Tooth-Ach occasion Swelling; where there is no Percussion at all ⁿ. See the Article PUTREFACTION.

SYMPATHY and ANTIPATHY.

*The Importance of the
Doctrine of
Sympathy and
Antipathy.*

1. The *Agreements* and *Disagreements* in Nature are the Spurs of Motions; and the Keys of Works: whence proceed the Union and Avoidance of Bodies; Mixture; Separation; the deep and intimate Impressions of Virtues; the Conjunction of active Bodies with passive; and, in short, the capital Things of Nature. But this part of Philosophy concerning the *Sympathy* and *Antipathy* of Things^o, otherwise call'd *Natural Magick*, appears exceedingly corrupted: tho, as is generally the Case, where Care has been wanting, there still remain'd Hope. Whence the Operation of this Doctrine upon Mankind, has a perfect resemblance with certain Narcotick Medicines; which, the same time they procure Sleep, cause pleasing Dreams. For first, it has render'd the Understanding drowzy, by crying up *specifick Properties*, *occult Virtues*, and *celestial Influences*; whence Men are no longer awake to the Discovery of *real Causes*, but indulge themselves in idle Notions, and fall asleep; at which Time, Hope insinuates numerous Figments, like so many Dreams. And thus vain Men hope to understand Nature by her Front, And Person; or to discover internal Properties by external Resemblances. and their Practice is exactly correspondent to this hopeful Procedure: For the Precepts of *Natural Magick* are such, as if Men trusted they could till the Ground, and eat their Bread, without any sweat of the Brow; or become Masters of every Thing by a few indolent and trifling Applications of one

^m But is the Practice safe; especially in large Contusions?

ⁿ The Cause here assign'd, seems to regard Contusions, and that kind of Swellings called by the Chirurgeons *humoural*; besides which, there are several others, viz. *OEdematous*, *Scrophulous*, *Cancerous*, &c. the efficient Causes whereof are not perhaps, sufficiently, known.

^o Let no Dislike be suddenly taken at the words *Sympathy*, and *Antipathy*: they mean the same as what we now call the *Laws of Nature*; only the Name being changed, whilst the Thing remains the same. Thus, for Instance, the *Laws of Attraction and Repulsion*, might as significantly be called the *Laws of Sympathy and Antipathy*. The Force of Words is very extraordinary; and should, if possible, be reduced to a Law: they have, at present, the Power of making old Things become new, and new Things become old. Thus, if the present Philosophy were put into ancient Language; there is Reason to believe it would lose much of its Currency. And if any ancient, discarded Philosophy were to be neatly dress'd up, in new Words and Phrases, there is Reason to believe it would have its Admirers: As in effect we find it often has had. This, if duly attended to, might serve to rectify a prevalent Error, or gross Idol of the Mind.

one Body to another ; then they have continually in their Mouths, and produce as Vouchers, on all occasions, Magnetism, the Attraction betwixt Gold and Quicksilver, and a few more Observations of this kind, to gain themselves a Credit in other Matters ; where there is by no means the same Relation. But Nature offers all that is excellent, to be purchased by a laborious search of the Mind, and Operation of the Body. We would, therefore, use our utmost Diligence in discovering the *Laws of Nature*, and interpreting the Alliances and Relations of Things ; without giving into Miracles, on the one Hand, or prosecuting a narrow grovelling Enquiry, on the other ^p.

2. All Bodies have an Appetite of Union ; and avoid a Solution of Continuity : and of this Appetite there are many degrees ; but the most remarkable are three ; the *first* in Liquors ; the *second* in hard Bodies ; and the *third* in tenacious Bodies. In Liquors this Appetite is weak : as appears by their falling in Threads, or round Drops ; and their Continuance, for a small time, in the form of Bubbles and Froth. In the *second* kind, this Appetite is strong ; as in Iron, Stone, Wood, &c. In the *third*, it is in a Medium, between the other two : for this kind of Bodies partly follow the touch of another, and partly stick and continue to themselves ; whence they rope and draw into Threads ; as Pitch, Glew, Bird-lime, &c. But all solid Bodies are more or less cleaving : and affect the touch of somewhat tangible, rather than of Air. For Water, in a small quantity, cleaves to any Thing that is solid ; so would Metal if the Weight did not draw it off : for Leaf Gold, or any Metal foliated, will cling. But the Bodies noted for being clammy and cleaving, are such as have a more indifferent Appetite, at once to follow another Body, and yet hold to themselves : whence they are commonly Bodies ill mixed ; that delight more in a foreign Body, than in preserving their own Consistence ; and not greatly abounding in dryness or moisture ^q.

The Appetite of Union in all Bodies, especially of three kinds.

3. 'Tis a *received Opinion*, that *Cantbarides* applied to any part of the Body, come in Contact with the Bladder ; and, if they remain long, exulcerate it^r. 'Tis likewise *received*, that a kind of Stone, which they bring

Observations of Sympathy and Antipathy with regard to medicinal Use.

G g 2

^p This was designed by the Author as an *Introduction to a particular History of the Sympathy and Antipathy of Bodies* ; after the same manner as the *History of Winds, Life and Death*, &c. but the History itself was never published. The Subject is certainly one of the principal in all *Physicks* ; and well deserving the Prosecution of Philosophers. But in an Affair so dark, and, indeed, so little fitted to the Capacities of the generality, we could earnestly wish for the Author's Direction. To have seen this noble Subject treated in his manner, like the Subject of Life and Death, for Example, might have shewn the direct way of perfecting the Enquiry ; or even have nearly executed the full Design. But for the following Attempt, it is a mere *Sylva*, or Collection of Materials, Experiments and Observations, that want much trimming, and pruning, to fit them for entering a particular History of *Sympathy* and *Antipathy*.

^q This Doctrine is now commonly resolved into *Attraction* ; as if when that word can be applied, there were an End of Enquiry. But whoever considers the Phenomena, will find their *efficient Causes* no nearer being discover'd, since the modern Use of this Term than before. In short, both the Terms, *Sympathy* and *Attraction*, seem used by the judicious, only to express the Phenomenon ; and not to assign the *efficient Cause*.

^r *Cantbarides*, tho externally applied, manifestly affect the Bladder ; or give the Strangury : as appears by numerous Instances, in the Application of Blister-Plaisters.

bring out of the *West Indies*, has a peculiar Virtue to dissolve the Stone in the Bladder; and even if applied but to the Wrist, to discharge Gravel violently †. 'Tis received, that the soles of the Feet have a great Consent with the Head, and the Mouth of the Stomach: and we see that going wet-shod, to those who are not used to it, will affect both. Applications of hot Powders to the Feet, first attenuate, and afterwards dry up the Rheum. And hence a Physician, to express himself mystically, prescribed for the Cure of a Rheum; that a Man should walk continually upon a *Camomile* Bed; meaning, that he should wear Camomile in his Socks. Again, fresh bleeding Pigeons are applied to the soles of the Feet to ease the Head: and soporiferous Medicines, applied to the same, provoke Sleep. It seems, that as the Feet have a Sympathy with the Head, so the Wrist and Hands have with the Heart. The Affections and Passions of the Heart and Spirits are remarkably discover'd by the Pulse: and 'tis often found, that the Juice of Stock-July-Flowers, Garlick, and other Things, applied to the Wrists, and renew'd, have cured inveterate Agues †. And I conceive, that washing the palms of the Hands with certain Liquors, may do good. It seems proper in the hot fit of an Ague, to hold in the hands Eggs of Alabaster, and Balls of Crystal †.

An Instance of Induration by Sympathy.

4. Make a little Cavity in the midst of melted Lead, when it begins to set; and lodge Quicksilver therein, tied up in a piece of Linen; and the Quicksilver will fix, so as to endure the Hammer. This seems a noble *Instance* of Induration, by the consent of one Body with another †; for it appears less reasonable to ascribe it only to the vapour of the Lead. *Quære*, whether Quicksilver may thus be so fix'd as to become figurable, like other Metals? For if so, Vessels might be made of it, provided they come not near the Fire †.

The secret Virtues of Sympathy and Antipathy, in Gems, and visible Objects.

5. There are many Things that operate upon the Spirits of Man, by *secret Sympathy and Antipathy*. That precious Stones have Virtues in the wearing, has been anciently and generally received; and they are said to produce several Effects. So much is true; that Gems have fine Spirits; as appears by their Splendour †: and therefore may operate, by Consent, upon the Spirits of Men, to strengthen and exhilarate them. The best Stones for this purpose are the Diamond, the Emerald, the Hyacinth, and the yellow

† This Stone does not at present maintain its Character.

† A proper Collection of this kind of Effects, well verified by repeated Trials, seems hitherto wanting; in order to lay a firm Foundation for a *Sympathetick Philosophy*; with regard to Medicine.

† See this Subject farther prosecuted by Mr. Boyle, in his *Discourse of Specifick Remedies*.

† Does the Author here mean that the Quicksilver fixes by Consent, as the Lead fixes? Or, to speak more intelligibly, tho less accurately, that the Quicksilver fixes because the Lead fixes? If this be the meaning, let it be tried, whether Quicksilver will not *sometimes* fix, by being suspended over melted Lead; whilst the Lead itself remains fluid.

† The common Experiment of making a Counterfeit Gold with Quicksilver, and Roman Vitriol, if it were not Contingent, might prove highly serviceable. And I have seen a yellow Metal of this kind, that might have easily imposed upon the Vulgar.

† Is this a necessary Consequence? But let it be consider'd, that Glass and Gems have a Power of reflecting Light, before it actually touches their Surface.

low Topaz^y. As for their particular Properties, no Credit can be given to them. But 'tis manifest, that Light, above all Things, rejoices the Spirits of Men: and, probably, varied Light has the the same Effect, with greater Novelty: which may be one Cause why precious Stones exhilarate. It were, therefore, proper to have tinged Lanthorns, or skreens of Glafs, colour'd Green, Blue, Carnation, Crimson, Purple, &c. and to use them with Candles in the Night: so likewise to have round, colour'd Glasses, that are stained thro'; or to have Colours laid between Crystals, and Handles to hold them by. Prisms, also, are pleasant Things. There are Looking-glasses, common at *Paris*, with broad Borders of Crystal; and large counterfeit Gems, of all Colours, that are very pleasant to the Eye; especially in the Night. The Pictures of *Indian* Feathers are likewise pleasing: and clear Streams recreate the Eyes and Spirits, especially by Moon-shine, or when the Sun is over-cast.

6. There are several sorts of Bracelets to comfort the Spirits; and of three Intentions, viz. *Refrigerant*, *Corroborant*, and *Aperient*. (1.) The *Refrigerant* may be of a Pearl, or Coral: and it has been noted of Coral, that if the Person who wears it, be indispos'd, it will turn pale; which may be true, because a hot Distemper makes it lose its Colour. I recommend also Beads, or little Plates, of *Lapis Lazuli*; and Beads of Nitre, either alone, or with some Cordial Mixture. (2.) For *Corroboration*, take such Bodies as are Astringent, without a manifest Coldness; as Bead-Amber, which is full of Astringency; yet unctuous, and somewhat warm. I recommend likewise Beads of Hartshorn and Ivory, which are of the like Nature; also Orange-Beads; and Beads of *Lignum Aloes*, first macerated in Rose-water, and dry'd. (3.) For *opening*, I recommend Beads of the Roots of *Carduus Benedictus*; the Roots of Male Piony; Orrice; *Calamus Aromaticus*; and of Rue^z.

Bracelets of three kinds.

7. The *Cramp* is probably a Contraction of the Sinews; as appears from its coming either by Cold or Dryness; as after Consumptions, and long Agues: for Cold and Dryness, both contract and corrugate. We see also, that chafing a little above the Part in Pain, eases the Cramp; by warming and dilating the contracted Sinews. There are two things in use to prevent the Cramp; viz. Rings of Sea-Horse Teeth worn upon the Fingers; and Fillets of green Periwinkle, tied about the Calf of the Leg, the Thigh, &c. where the Cramp usually comes. This seems the more strange, because neither of them has any relaxing Virtue, but rather the contrary: Whence they appear to operate rather upon the Spirits in the Nerves, than upon the Substance of the Nerves themselves^z.

The Cause and Cure of the Cramp by external Applications.

8. Light

^y See Mr. Boyle upon the *Origin and Virtues of Gems*.

^z There seem not to have been sufficient Trials made of these Things; in order to form a valid Judgment upon them.

^a The Terms *Nerves* and *Sinews* seem to be here used as convertible: but in the anatomical Sense, they are widely different; the Sinews being properly not *Nerves*, but the *Tendons of the Muscles*: and in this Sense, an involuntary Contraction of the Tendons, or rather, perhaps, of the Belly of a Muscle, may be the Cause of the Cramp, or the actual Cramp itself.

An imperfect
Axiom form'd
upon it.

8. Light may hence be derived, to shew how Things which stop the struggle of the Spirits, help in Diseases, contrary to the Intention : for in curing the Cramp, the Intention is to relax the Sinews ; but the Contraction of the Spirits, that they may struggle less, is the best Remedy. So, to procure easy Travail, the Intention is to bring down the Child ; but the best help is, to prevent its coming down too fast. So, in pestilential Fevers, the Intention is to expel the Infection, by Sweat and Exhalation ; but the best means to do it is by Nitre, and other cool Things ; which for a time arrest the Expulsion, till Nature can effect it more quietly. It seems to be an excellent AXIOM, and of great Use, that *whatever appeases the Struggle of the Spirits, promotes their Action* ^b.

Whence the
Virtue of Piony
in the Epilepsy.

9. It has been long received, and confirmed by Trial, that the dried Root of the *Male-Piony*, tied to the Neck, helps in the Falling-Sickness ; and likewise in the *Incubus* or *Night-Mare*. The Cause of both these Diseases, and especially the Epilepsy, may be the grossness of the Vapours from the Stomach ; which rise and enter the Cells of the Brain : so that the Effect is here perform'd by the extreme and subtile attenuating Virtue of the Simple. I judge the like of *Castor*, *Musk*, *Rue-Seed*, the Seed of *Agnus Castus*, &c.

Instances of
Virtue in Bo-
dies wore ex-
ternally.

10. To wear the Blood-stone, is thought good against bleeding at the Nose : and may have its Effect by astringing and cooling of the Spirits. It has been anciently received (for *Pericles* used it) and is still practised, to wear little Bladders of Quicksilver, or Tablets of Arsenick, as Preservatives against the Plague : not for any assistance they yield the Spirits, but because, being Poisons, they attract the Malignity ^c.

Instances of
Sympathetical
Effects on dif-
ferent Crea-
tures.

11. We see Scare-Crows are set up, to keep Birds from Corn and Fruit ; and 'tis reported, that the Head of a Wolf, dried and hung up in a Dove-house, will frighten away Weasles, Polecats, &c. and perhaps the Head of a Dog will do as much ; for those Vermine with us, know Dogs better than Wolves.

Brains eaten
to strengthen
the Memory.

12. The Brains of some Creatures roasted, and taken in Wine, are said to strengthen the Memory ; as the Brains of Hares, Deers, &c. And this seems peculiar to the Brains of those Creatures that are fearful ^d.

The Ointment
of Witches.

13. The Ointment of Witches, is reported to be made of the Fat of Children, dug out of their Graves ; the Juices of Smallage, Wolfsbane and Cinque-

^b This intimates a method of interpreting Nature, for the perfecting of Practice ; which Philosophers make so little Use of, that it should seem they do not know there is any such Method practicable to Advantage. And when they will be sensible of it, so as to endeavour the improvement of Medicine by its means, is uncertain. To talk of forming *Aphorisms*, investigating Causes, and raising *Axioms*, is talking in a Language almost unknown ; and yet, unless these Things be procured, neither Philosophy nor Medicine can be considerably improved.

^c The wearing of *Arsenick*, in the way of Amulet, having had poisonous Effects, is now justly laid aside. The practice has been common in times of the Plague ; and is said to have arisen chiefly from an ignorance of *Arabick* ; the word in the *Arabian* Authors which is render'd *Arsenick*, properly signifying *Cinnamon*.

^d Little Credit can be given to these Relations, for any thing that has hitherto been approved upon competent Experience.

Cinquefoil, mix'd with fine Wheat-Flower. But, I suppose, the soporiferous Simples, are fittest for this Purpose; such as, *Henbane, Hemlock, Mandrake, Moonshade, Tobacco, Opium, Saffron, &c.*

14. It has been observed, that the Diet of Women with Child affects the Infant; so, for the Mother to eat Quinces, and Coriander-Seed, in large Quantities, which repress Vapours that would ascend to the Brain, makes the Child ingenious: and, on the contrary, to eat largely of Onions, Beans, or such flatulent Food; to drink Wine, or spirituous Liquors immoderately; to fast much; or be given to musing; all which send Vapours to the Head; endangers the Child's becoming Lunatick, or of weak Memory. And I judge the same of Tobacco often taken by the Mother^e.

The Diet of pregnant Women affects the Infant.

15. The Flesh of a Hedge-hog dress'd and eaten, is said to be a great drier: and indeed the Juice of a Hedge-hog, should seem to be harsh and dry; because it puts forth so many Prickles. For *Plants that are full of Prickles prove generally dry: as Briars, Thorns, Barberries, &c.*^f and hence the Ashes of a Hedge-hog are said to be a great Desiccative in Fistula's.

Effects of a Hedge-Hog's Flesh.

16. Mummy has a great Virtue to stop Bleeding; which may be ascribed, in some measure, to its mixture of Balsams that are glutinous; and also to a *secret Property*; because the *Blood attracts Man's Flesh*. And 'tis approved that the Moss growing upon an unburied Skull, stops Blood powerfully: so does the Powder of Blood, separated from the Serum, and dried^g.

The Styptick Virtue of Mummy and Skull Moss.

17. 'Tis reported, that the white of an Egg, or Blood, mix'd with Salt-water, collects the Saltiness; and makes the Water sweeter. This may be effected by Adhesion; as in Clarification. Perhaps also Blood, and the white of an Egg, have some Sympathy with Salt: as all Life has. We see that Salt applied to a cut Finger heals it; whence Salt appears to attract Blood, as well as Blood attracts Salt.^h

That Blood attracts Salt.

18. It has been *anciently received*, that the *Sea-hare* hath an *Antipathy* to the Lungs; so as if it comes near the Body to corrode them. The Cause is conceived to be, a quality the Hare has of heating the Breath and Spirits; as *Cantharides* operate upon the watry Parts of the Body. And 'tis a good Rule, that *whatever operates upon a certain kind of Matter, operates most upon those Parts of the human Body, which abound with that kind of Matter*ⁱ.

The Antipathy of the Sea-Hare to the Lungs.

19. What

^e These Particulars require better Confirmation.

^f These larger Observations which offer at a just Interpretation of Nature, or Attempts for the raising of *Axioms*, cannot be too carefully noted; as well for their own sakes, as the Example they hold out, of the End to which all physical Enquiries should be directed.

^g There is something extraordinary intimated here: but we dare not pronounce upon it, for want of a sufficient number of competent Experiments.

^h Does Blood attract Salt by any other than its aqueous Part? There are other Queries to be proposed upon this Head; but for our own part, we had rather rise up to make Experiments, than sit down to ask Questions: and to say the Truth, Experiments are the only Answers of any significance in all these Cases; for Conjectures, and Talk, and Reasoning, without them, are childish and impertinent Things.

ⁱ I would willingly avoid an over-officiousness in pointing out the more fundamental Parts of this Piece: but the numerous *Axioms* latent in it, have been so little regarded, and Philosophers are usually so little acquainted with the infinite Use of *Canons, large Observations, and Axioms*, that 'tis in a manner necessary to indicate them as often as they occur.

The Antipathy in living Bodies to dead ones; and sound ones to corrupted.

19. What is dead, corrupted, or voided, has generally an *Antipathy* with the same thing alive, or sound; and with the discharging Parts: thus the Carcass of a Man is most infectious and odious to a Man; the Carrion of a Horse to a Horse, &c. purulent Matter, Ulcers, Carbuncles, Scabs, &c. to sound Flesh; and the Excrement of every Species to the Creature that discharges them: but Excrements are less pernicious than Corruptions. 'Tis a common Observation, that Dogs know the Dog-killer: for when in times of Infection, some petty Fellow is sent out to kill the Dogs; tho they have never seen him before, yet they will all come out and bark and fly at him ^k.

Whether the Minds of Men may have secret Notices of Events.

20. The Relations as to the *Force of Imagination*, and the *secret Instincts of Nature*, are so uncertain, that they require a deal of Examination, before we conclude upon them. I would have it thoroughly examined whether there be any secret *Passages of Sympathy*, between Persons near in Blood; as Parents, Children, Brothers, Sisters, Husbands, Wives, &c. There are many *Reports* in History, that upon the Death of Persons nearly related, Men have an inward feeling of it. I myself remember, that being at *Paris*, and my Father dying in *London*, I had two or three Days before his Death, a Dream, which I told to several *English* Gentlemen; that my Father's House in the Country was plaster'd all over with black Mortar ^l. There is an *Opinion* abroad, whether idle or no, I cannot say; that affectionate and tender Husbands have a Sense of their Wives breeding, by some Accident in their own Body ^m.

Whether an intermediate Person may have these Notices.

21. Next to those near in Blood, there may be the like Passage, and Instincts of Nature, between great Friends and Enemies: and sometimes the Notice is given to a second Person. *Philip de Commynes*, a grave Writer, reports, that the *Archbishop of Vienna* said, one Day after Mass, to *Lewis* the XIth of *France*: Sire, *Your mortal Enemy is dead*; at which time, *Charles Duke of Burgundy* was slain in the Battle of *Granson* against the *Switz*. Trial also should be made, whether Compact or Agreement has here any Effect; as if two Friends should agree, that such a Day in every Week, they being in distant places, should pray for each other; or put on a Ring for each others Sake; to try whether if one should break his Promise, the other would have any feeling of it, in Absence ⁿ.

22. If

^k This is a pregnant Aphorism, and an extensive Observation to the present purpose; that from direct Phenomena, searches deep into Nature.

^l It is certainly difficult for Men educated in the common way, to enquire strictly and philosophically into this part of the present Subject. The Mind seems almost to dread it; as if fearful of discovering more than Reason is willing to allow.

^m Such Particulars as these ought to be diligently enquired after, if we desire to have any tolerable Knowledge of the Subject in Hand; but few Philosophers are able to keep their Countenance at the mention of them.

ⁿ These Experiments have not, perhaps, been made; at least not by the proper Persons; who should, doubtless, be Men or Women of strong Faith, or Imagination: but then they should also be Persons of great Veracity; or join Men of more Solidity along with them: otherwise we might be easily imposed upon. And to say the Truth, Experiments of this kind are attended with great difficulty and uncertainty. For the Method of facilitating and rendering them more stable, See the Article IMAGINATION.

22. If there be any Force in the Imaginations and Affections of single Persons ; it is probably much greater in the joint Imaginations and Affections of Multitudes. If a great Battle should be won or lost in a remote Country, is there not some Sense thereof in the People it concerns ; because of the great Joy, or Grief, that Men are sometimes possessed with at once ? *Pius Quintus*, at the very time that memorable Victory was gained by the Christians against the *Turks*, in the Sea-fight of *Lepanto*, being then hearing Causes in the *Consistory*, broke off suddenly, and said to those about him, *it is now rather time that we should give Thanks to God, for the great Victory he has granted us against the Turks*. 'Tis true, that Victory had a Sympathy with his Spirit ; for it was merely his Work to conclude the Treaty. It may be this Revelation was Divine : but what shall we say to a number of Examples among the *Grecians* and *Romans* ; where the People being in the Theatre, have had News of Victories and Overthrows, some Days before any Messenger could arrive ° ? The general Root of Superstition may indeed hold in these Things ; viz. *that Men observe when Matters hit, but not when they miscarry* : and commit the one to Memory, but forget the other.

23. We have already laid down some Rules for making Experiments upon the Power of *Imagination* ; and added some Means of fortifying it ; together with a few Directions and Instances of its Force upon Beasts, Birds, Plants, and inanimate Bodies : constantly requiring that the Trials be only made upon subtle and light Motions ; for you will sooner, by Imagination, bind a Bird from singing, than from eating or flying : and I leave every Man, to chuse the Experiments, which himself thinks most commodious. But to add a few Examples ; observe to use some Imaginant, according to the former Rules ; for binding a Bird from singing, or a Dog from barking. Try also the Imagination of Persons whom you shall accommodate with Things to fortify it, as in Cock-fightings, to make one Cock more courageous, and the other more cowardly. Try it also in the flying of Hawks, chasing of Deer, Horse-Races, and the like comparative Motions : for 'tis easier by Imagination to accelerate, or check a Motion, than to raise, or stop it ; as 'tis easier to make a Dog go slower, than to make him stand still.

Examples for operating by the Imagination in Animals.

24. In Plants also, let the Force of Imagination be tried upon the lighter sort of Motions : as upon the sudden fading, or lively vegetation of Herbs ; or upon their bending one way or other ; or upon their closing and opening, &c. And in Things inanimate, try the Force of Imagination, upon stopping the working of Beer, when the Yeast is put to it ; or upon the coming of Butter, or Cheese-Curd, after the Churning, or the addition of the Rennet.

In Plants and inanimate Bodies.

° But might not these be State-Artifices ; used to feel the Pulse, or raise the Spirits of the People ?

° See the Article IMAGINATION.

The benumbing
Faculty of the
Torpedo.

The Parts of
Animals may
have more Vir-
tue if sepa-
rated from
them Living.

Trials to be
made by sepa-
rating the
Parts of Indi-
viduals.

Love Tokens.

The stroking of
Warts.

25. 'Tis every where alledged as an Example of *secret Properties and Influences*, that the *Torpedo*, if touched with a long Stick, stupefies the Hand^a. And 'tis one degree of working at a Distance, to work by the Continuation of a fit Medium : thus, Sound will be convey'd to the Ear, by striking upon a Bow-string, if the Horn of the Bow be held to the Ear.

26. The Writers of *Natural Magick* attribute much to the Virtues remaining in the parts of Animals, if taken from them alive : as if the Creature in that Case infused some immaterial Virtue, or Vigour, into the separated part. So much may be true, that any part taken from a Creature newly killed, may be of greater Force, than if taken from the like Creature dying of itself ; as being fuller of Spirit.

27. Trial should be made in the like parts of Individuals ; as by cutting off part of the Stock of a Tree, and laying it to putrefy ; to see whether this will decay the rest of the Stock : or cutting off part of the Tail, or Leg of a Dog or Cat, and laying it to putrefy ; to see whether this will keep the other part from Healing.

28. 'Tis supposed, a help to the Continuance of Love, to wear a Ring, or Bracelet of the Person beloved : but this may proceed from exciting the Imagination ; which perhaps a Glove, or other the like Favour might do as well.

29. The *Sympathy of Individuals*, that have been entire, or in Contact, is of all others the most incredible. To take away Warts, by rubbing them with somewhat that is afterwards put to consume, is a common Experiment. I had from my Childhood a Wart upon one Finger : afterwards when I was about sixteen, being then at *Paris*, there grew upon both my Hands a number of Warts, at least a hundred, in a Month's Time. The *English* Ambassador's Lady, who was far from Superstition, told me, she would get away my Warts : and in order to it, she rubbed them all over with the fat side of a piece of Bacon, with the Rind on ; and among the rest, the Wart, I had from my Childhood : then nail'd the Bacon, with the Fat towards the Sun, upon a Post of her Chamber-Window, which was to the South : and in five Weeks time the Warts went quite away ; and the Wart I had so long endured, for Company. At the rest I did not much wonder ; because as they came in a short time, they might go away so too : but the vanishing of that which had remained so long, sticks with me. They say, the like is done by rubbing Warts with a green Elder-stick ; and burying the Stick. The Experiment might be tried on Corns, Wens, and other Excrecences. I would have it also tried on some Parts of living Creatures, that approach nearest to Excrecences ; as the Combs and Spurs of Cocks, the Horns of Beasts, &c. And let it be tried, both by rubbing those Parts with Bacon or Elder ; and by cutting off some piece of them, and burying it : to see whether this will have any Effect towards consuming the part once join'd with it.

30. 'Tis

^a Does the Stupefaction caused by the touch of the *Torpedo*, proceed from any thing more than a particular Motion, whereby the Creature lets itself off, as it were, upon being touched ? See a curious Paper upon this Subject in the *French Memoirs*.

^b There are many Experiments of this kind related ; but no proper Collection of them, made, with the requisite Care for forming a just Rule, or solid Judgment, upon them.

30. 'Tis constantly avouched, that to anoint the Weapon which gives the Wound, will heal the Wound itself. In this Experiment, which I have upon the relation of credible Persons, tho I am not fully inclined to believe it, 'tis observed, (1.) That the Ointment employ'd consists of several Ingredients; whereof the strangest and hardest to procure, are the Moss growing upon the Skull of a dead Man unburied, and the Fat of a Boar, and a Bear, kill'd in the Act of Generation. *The two last I could easily suspect prescribed as a Loop-hole; that if the Experiment did not succeed, it might be pretended the Beasts were not kill'd at the right Time;* but for the Moss, there is a great quantity of it in Ireland, upon slain Bodies, laid on Heaps, unburied. The other Ingredients are, Blood-stone in Powder, and some Things, which seem to have a Virtue to stanch Blood; as the Moss also has. The Description of the whole Ointment is found in *Crollius's* Chemical Dispensatory. (2.) The same kind of Ointment applied to the Wound itself, has not the Effect; but only when applied to the Weapon. (3.) They do not observe to prepare the Ointment under any certain Constellation; so have not the Excuse made for the failure of magical Medicines. (4.) It may be applied to the Weapon, tho the Person hurt be at a great Distance from it. (5.) It seems, the Imagination of the Person to be cured is not necessary; for it may be done without the Knowledge of the wounded: and it has been tried, that if the Ointment be wiped off the Weapon, without the Knowledge of the Patient, he is presently in violent Pain, till the Weapon be re-anointed. (6.) 'Tis affirm'd, if the Weapon cannot be procured, and an Instrument of Iron, or Wood, resembling the Weapon, be put into the Wound, so as to make it bleed; the anointing of that Instrument will have the Effect. *This I suspect is a Device to keep so strange a form of Cure in Request and Use: because many times one cannot procure the Weapon itself.* (7.) The Wound must be first wash'd clean with White-wine, or the Persons own Urine; and then bound up close with fine Linen: and no more Dressing is required. (8.) The Weapon itself must be wrapped up close, as far as the Ointment goes, that it takes no Wind. (9.) The Ointment, if wiped off from the Weapon, and kept, will serve again; and rather increase in Virtue than diminish. (10.) It cures in far shorter time than vulnerary Ointments commonly do. (11.) It cures a Beast as well as a Man; which subjects the Matter to an easy Trial^e.

The Weapon-salve.

31. The Delight we take in Popularity, Fame, Honour, the subduing and subjecting other Mens Minds, Wills or Affections, seems in itself, without regard to Consequences, grateful and agreeable to the Nature of Man. This surely is not without some Signification; but seems as if the Spirits and Souls of all Men, came out of one divine *Limbus*: else why should we be so much affected with what others think or say? The best Temper of Mind desires a good Name, and true Honour; the lighter sort, Popularity and Applause:

The general Sympathy of Mens Spirits.

H h 2

the

^e Those who desire farther Information upon this extraordinary Head, may consult Sir *Kerelm Digby*, and Mr. *Boyle*.

the more depraved, Subjection and Tyranny ; as we see in great Conquerors and Disturbers of the World ; and yet more in Arch-hereticks : for the introducing of new Doctrines, is an affectation of Tyranny over the Understandings and Opinions of Men.

T.

TEETH.

*The Tenderneſs
of the Teeth,
whence.*

THE Teeth are more affected by Cold, in drinking cold Liquors, or the like, than other Parts ; becauſe Reſiſtance of Bone to Cold, is greater than that of Fleſh : for Fleſh ſhrinks, but Bone reſiſts ; whereby the Cold becomes ſharper. Again, the Teeth are without Blood ; but Blood helps to qualify Cold : whence the Sinews are much affected with Cold, as being Parts without Blood. So the Bones, in ſharp Cold, grow brittle ; and therefore all Contuſions of the Bones are harder to cure, in froſty Weather *. See the *Article* BONES.

TIME.

*The contrary
Operations of
Time upon
Fruits and
Liquors.*

Time changes Fruits from ſour to ſweet ; but potable Liquors from ſweet to ſour. The *Cauſe* is, the collection of the Spirits together ; for in both kinds the Spirit is attenuated by time : but in the firſt 'tis more diffuſed, and ſubdued by the groſſer Parts, which the Spirits only diſeſt ; whiſt in Drinks the Spirits reign, and finding leſs oppoſition of the Parts, become themſelves more ſtrong, and thus ſtrengthen the Liquor : ſo that if the Spirits be of the hotter ſort, the Liquor becomes apt to burn ; but in time, when the higher Spirits are evaporated, it cauſes likewiſe more Sourneſs †.

TITILLATION.

*The Cauſe of
Titillation.*

Tickling is moſt felt in the Soles of the Feet, under the Arm-pits, and on the Sides ; from the thinneſs of the Skin, joined with the ſeldomneſs of being

* Tho the Materials here collected, are no way ſufficient to build up a *Sympathetical Philoſophy* ; yet they may, perhaps, afford many Intimations and Directions for one. Certainly there are, in Nature, great numbers of *Phænomena*, and *Effects*, not to be accounted for upon *Mechanical Principles* ; or the vulgar Doctrine of *Matter and Motion* : but require ſublimer Solutions. Whence proceeds the Influence and Aſcendency which one Man's Mind has over another : whence the Attraction, Repulſions, and more ſecret Relations in Bodies ; of which the Inſtances are numerous ; particularly in the Doctrine of *Menſtruums* ? If proper Collections were made, of the more capital *Inſtances* of this kind ; if the common *Sympathetic Experiments* were repeated with Care and Judgment, and their Number enlarged ; if the common Traditions upon this Subject were ſifted and purged ; and laſtly, if a Set of judicious and experienced Philoſophers were, for ſome time, employ'd in this Way ; we ſhould then ſee whether a Harveſt of ſerviceable *Canons*, and *Axioms* might not be reaped, for extending, improving, and perfecting the common *Phyſicks* ; which, for want thereof, appears but a lifeleſs Thing.

† Senſation is uſually denied to Bone ; any farther than the Nerves are affected by its means.

‡ The due ſettling of this Point depends upon a Knowledge of *Fermentation* and *Acetiſication*. See *Boerhaave's Chymiſtry*, and *Stahl's Zymotechnia*.

being touched in those Parts : for all tickling is a light Motion of the Spirits, promoted by the thinness of the Skin, and the suddenness and unfrequency of Touch : so a Feather tickles by being drawn along the Lip, or Cheek ; but not a thing more obtuse, or a stronger Touch. As to Suddenness ; we find no Man can tickle himself : and the Palm of the Hand, tho it has as thin a Skin as the Parts above-mentioned, yet is not ticklish ; because accustomed to be touched. Tickling also causes Laughter ; perhaps from the emission of the Spirits, and so of the Breath ; for, upon tickling, there is always a starting, or shrinking away of the Part, to avoid it : and if the Nostrils be tickled with a Feather, or Straw, it procures Sneezing ; which is a sudden emission of the Spirits, that, likewise, expel the Moisture. And tickling is always painful, and not well to be endured ^v. See the *Article* VENERY.

T O B A C C O.

Tobacco is a thing of great Profit, if it be in request ; tho the Charge of making the Ground, and otherwise, is considerable : but the *English* Tobacco has little Reputation ; as being too dull and earthy. So that, to render Tobacco more aromatic, and better concocted, here in *England*, might be a very beneficial thing. Some have attempted it by drenching *English* Tobacco in a Decoction of the *Indian* : but such Methods are Sophistications and Toys ; for NOTHING THAT IS ONCE PERFECT, AND HAS RUN ITS COURSE, CAN RECEIVE MUCH AMENDMENT. *We* MUST EVER RESORT TO THE BEGINNINGS OF THINGS FOR MELIORATION ^x. The Way of ripening Tobacco must, as in other Plants, proceed from the heat, either of the Earth, or the Sun. We see something of this kind practised in Muskmelons, which are sown in a hot Bed, exposed to the South-sun, and laid upon Tiles, to increase the Heat by Reflexion ; and covered with Straw, to defend them from the Cold. They also remove them ; which adds some Life : and by such Helps the Melons become as good in *England* as in *Italy*, or *Provence*. These, and the like Means, may be tried in Tobacco. Enquire also, of steeping the Roots in a Liquor that may give them Vigour to put forth strongly ^y.

*The Means of
meliorating
Tobacco.*

T O N G U E.

The Tongue more easily receives Impressions, and affords more Tokens of Diseases, than other Parts ; as of Heats within, which appear most in the blackness of the Tongue. And pied Cattle are spotted in their Tongues, from the tenderness of the Part ; which thence receives all Alterations more easily, than other parts of the Flesh ^z.

*Whence the
Tongue gives
early Signs of
Diseases.*

T R A N S.

^v This Article belongs to a sublimer *Anatomy* than the common.

^x These are two Axioms of great importance ; and, if well explained, might afford much light in the conducting of Works ; and the introducing of Meliorations.

^y There seems to be no great Occasion, at present, for cultivating Tobacco in *England* ; otherwise the Method, perhaps, is no Secret ; being successfully practised in the South parts of *France*.

^z Some Indications are taken from the Tongue in Distempers ; but the Interpretations of its Signs are not well settled.

TRANSMUTATION.

*That Air preys
upon Moisture.*

1. The Eye of the Understanding is like the Eye of the Sense: for as large Objects are visible thro' small Chinks; so are great AXIOMS of Nature thro' small and ordinary Instances^a. The quick Depredation which Air makes upon watry Moisture, and its converting the same into Air^b, appears in nothing more plain than in the sudden Dissipation of the little Cloud, made by breathing upon a Glass, a Sword-blade, or any such polished Body that does not detain, or imbibe the Moisture; which here scatters and breaks up suddenly: whereas, the like Cloud remains long, if it were oily or fat; not because it sticks faster, but because it is *Air that preys upon Water*; and *Flame and Fire, upon Oil*^c: whence, to take out a Spot of Grease, we use a Coal upon brown Paper; for Fire operates upon Grease, as Air does upon Water: and we see oiled Paper, or oiled Wood, will long remain moist; but grow dry, or putrefy sooner, when wet with Water: for Air has little effect upon the Moisture of Oil^d.

*The force of
Union to be
subdued in
Conversions.*

2. The same trifling Instance of the little Cloud upon Glass, Gems, &c. admirably shews how much the Force of Union, even in the least Quantities, and weakest Bodies, conduces to preserve the present, and resist a new Form. For this little Cloud constantly breaks up first in the Skirts, and last in the middle. We see likewise, that much Water draws out the Juice of a Body infused therein; whilst little Water is imbibed by the Body: and this is a principal Cause, why, in Operations upon Bodies for their Alteration, Trials, in large Quantities, do not answer to the Trials in small; and so impose upon many: for the greater the Body, the more it resists any Alteration of Form; and requires much more Efficacy in the active Body, that should subdue it^e.

*The Means of
producing Ani-
mals of un-
common Co-
surs.*

3. Anoint Pigeons, or other Birds, when in their Down; or very young Whelps, &c. first cutting their Hair as short as possible, with some innocent Ointment that will harden, and stick very close; to try whether it will not alter the Colour of the Feathers, or Hair. Pulling the first Feathers of Birds clean off, is said, to make the new come white: and, 'tis certain, *White is a penurious Colour, that rises where Moisture is deficient*^f.

So

^a A due Collection of which Instances, is the readiest and surest way of forming such AXIOMS.

^b Whether this be an Instance of the actual conversion of Water into Air, may be questioned. How does the Experiment succeed in *Vacuo*?

^c Is Water the *Pabulum* of Air; as Oil is of Fire?

^d More than one great Axiom of Nature is here intimated, that cannot perhaps be justly formed, without a farther Improvement of Chemistry; particularly that Part thereof which relates to the common Elements; or grand Instruments of the Art. See Boerhaave's Chemistry; but particularly, the Chapters of Fire, Air, Water, Earth, and Menstruums; which are considerably improved in his own Edition.

^e Here again are the Rudiments of an Axiom; containing great light of Information, in the conducting of Works, and the Business of Transmutation.

^f This is a large, or very extensive Observation; as may appear by the subsequent Instances, from which it seems to have been drawn.

So blue Violets, and other Flowers, if starved, turn pale and white: Birds, and Horses, by Age, or Scars, turn white: and the hoary Hair of Men, proceeds from the same Cause. 'Tis therefore, probable, that the first Feathers of Birds will often prove of different Colours, according to the Nature of the Bird; whilst the Skin is more porous: but that *when the Skin is more close, the Feathers will come white*. This Experiment may serve, not only to produce Birds and Beasts of strange Colours; but also to disclose the Nature of Colours; and shew which of them require a finer, and which a coarser Strainer^s. See the *Articles* COLOURS, and PERCOLATION.

4. In *Transmutations*, or grand Alterations of Bodies, there always comes a Medium between the Matter as it is at first, and the resulting Matter; which Medium, is a Body imperfectly mixed, and not durable; but transitory; as Mist, Smoke, Vapour, Chyle, and the Rudiments of Animals: and the middle Action, which produces such imperfect Bodies, is, by some of the Ancients, aptly called *Inquination*, or Inconcoction; being a kind of Putrefaction: for the Parts are in confusion, till they settle one way or other^b.

A fundamental Observation with regard to Transmutation.

5. 'Tis reported, that Sailors having, every Night, hung Fleeces of Wooll on the Sides of their Ships at Sea, could squeeze fresh Water out of them, in the Morning. And, we have tried, that a Quantity of Wooll, tied loose together, being let down into a deep Well, about three Fathom from the Water, for a Night, in the Winter, increased in weight about a Fifth part^c.

Experiments relating to the Transmutation of Air into Water.

6. 'Tis reported, that in *Lydia*, near *Pergamus*, certain Workmen, in the time of War, taking refuge in Caves, which being stopped by the Enemy, the Men were starved; but, that the dead Bones were, long after, found, and some Vessels which they had carried with them; the Vessels being now full of Water, that was thicker, and nearer approaching to Ice than common Water:

^s We have here an Instance of an Attempt to raise a *Work* upon the Cause derived, or endeavoured to be derived, under the *Article* PERCOLATION, § 7. If this Cause were verified, or found to be certainly true; it would become an *Axiom*: and the Work here intimated would then certainly prove successful, for the End purposed. How far it may succeed, has not perhaps been properly tried. At least, we may hence learn the Scope and Nature of this whole Piece of the *Sylva Sylvarum*; which is to discover Causes, and form them into pregnant *Axioms*, that readily direct to Works. And certainly, whoever shall understand, and properly practise this Method, may produce, not only strange, but highly useful and serviceable Effects. The great Inconvenience is, that Persons well versed in this Way, might, in ignorant Ages, or ignorant Countries, be taken for Magicians: of which gross and fatal Mistake there are but too many Instances.

^b We have here a *large Observation* of very general Extent, the capital Instances whereof deserve to be collected, in order to raise it into an *Axiom*, or *Rule* of Practice. For, thus to operate by *Transmutation*, it should seem that the Subject ought to be softened, rarified, or subtilized; that being a Form the most susceptible of Change. The Doctrine of the Adepts may deserve to be considered upon this Occasion.

^c Instances of this kind can only be considered as *Instances of Approach*, with regard to the present Subject of *Transmutation*; being, perhaps, no more at bottom than Methods of collecting the invisible aqueous Particles that float in the Air, (especially near Water) and rendering them sensible: which is far from a *Transmutation*. See the *Articles* ALTERATIONS, CONCOCTION, GOLD, and PUTREFACTION.

Water : which is a remarkable *Instance of Condensation by long burial* ^k; and of *Transmutation*, as it should seem, of Air into Water ; provided any of the Vessels were at first empty. Try, therefore, small Bladders of Air, immersed in Snow, in Nitre, and in Quicksilver : and if you find the Bladder shrunk, the Air will appear condensed by the cold of those Bodies ; as it would be in a Cave ^l.

7. It is credibly reported, that in the *East-Indies*, if a Tub of Water be set open in a Room where Cloves are kept, it will be drawn dry in twenty-four Hours ; tho it stand at some distance from the Cloves. And often, when Wooll is new shorn, our Country People fraudulently set some Pails of Water in the same Room, to increase the weight of the Wooll. But, perhaps, the heat remaining in the Wooll from the Body of the Sheep, or gathered by the close lying, helps to draw the watry Vapour.

8. 'Tis also credibly reported, that Wooll new shorn, being casually laid upon a Vessel of Verjuice, had, after some time, drunk up great part of the Liquor ; tho the Vessel were without Flaw, and remained close. So that there was a Percolation of the Verjuice thro' the Wood, in a kind of Vapour.

9. What facilitates the conversion of Air into Water, when the Air is not gross, but subtilly mixed with tangible Bodies ; is, that tangible Bodies have an Antipathy to Air : and if they find any Liquid more dense near them, they will attract it, condense it more, and, in effect, incorporate it. Thus a Sponge, Wooll, or Sugar, being in part put into Water, or Wine, attract the Liquor higher than the Surface reaches. So Wood, Lute-Strings, &c. will swell in moist Seasons ; as appears by the breaking of the Strings, the hard turning of the Pegs, &c. which is a kind of Infusion much like Infusion in Water ; that makes Wood swell : as in closing the Cracks of Bowls, by laying them in Water.

10. There appears also to be a conversion of Air into Water, in the sweating of Marble and Wainscot, in moist Weather. Which proceeds either from some Moisture the Body yields ; or because the moist Air is condensed against the hard Body. But it seems plainly the latter ; for Wood painted with Oil-colours, will sooner gather Drops in a moist Night, than Wood alone ; because of the smoothness and closeness, which admits no part of the Vapour ; and therefore turns back, and condenses it into Dew : as breathing upon a Glass, or other polished Body, makes a Dew. So likewise, in frosty Mornings, we find Drops of Dew on the inside of Glass-windows : and the Frost itself upon the Ground, is but a Condensation of the moist Vapours of the Night. Dew also, and Rains, are only the Returns of moist Vapours condensed : the Dew being condensed by the Cold from the Sun's Departure ; and Rains, by the Cold of the middle Region of the Air.

11. 'Tis

^k See the *Article* BURIALS.

^l Neither the utmost force of *Cold*, nor of the *Condenser*, seem to have been tried for this Purpose. See the *Chapter of Fire* in *Boerhaave's Chemistry* ; where a Method is shewn of procuring an extreme degree of artificial Cold, by means of Ice and Spirit of Nitre.

11. 'Tis probable, that what will turn Water into Ice, may likewise turn Air, in some degree, to Water. Therefore try the common Experiment of turning Water into Ice, by Art¹; using Air instead of Water. And tho it be a greater Alteration to turn Air into Water, than Water into Ice; yet there are hopes, that by continuing the Air longer, the Effect will follow: for the artificial conversion of Water into Ice, is the Work but of a short time; whereas this may be tried for a Month, or more.

12. There seem to be these probable Ways of converting *Vapour*, or *Air*, into Water and Moisture. The *first* is by *Cold*; which manifestly condenses, as we see by the contraction of the Air in the Weather-glass: whence Air by Condensation appears to come a degree nearer to Water. We see it also in the Origin of Springs; which the Ancients thought owing to the conversion of Air into Water, promoted by the coldness of the Rocks; where Springs are chiefly generated. We see it also in the Effects of the Cold of the middle Region of the Air; which produces Dews and Rains. And the Experiment of turning Water into Ice, by means of Snow and Salt, should be tried, as we before observed, for turning Air into Water. The *second Way*, is by *Compression*; as in Stills, where the Vapour is turned back upon itself, by the Sides of the Still: and again, in the Dew visible upon Marble and Wainscot, towards damp Weather. But this is likely to have no great Effect, except upon Vapour and gross Air, already approaching near to Water. The *third* is, by *mixing* moist Vapours with Air, and trying if they will not produce a greater return of Water; for if so, that Increase is a conversion of the Air. Therefore put a certain weight of Water into a close Still, and hang a large Sponge above the Water, to try what Quantity of Water may, after heating, be squeezed out of it, in proportion to the Water spent; for, if any Conversion can be wrought, it will be easiest effected in the small Pores of Bodies; which is the reason we prescribe a Sponge. The *fourth Way* is, by receiving the Air into the small Pores of Bodies; every thing in small Quantity being, as we have before observed, more disposed for Conversion; and all tangible Bodies endeavouring to condense Air: but in entire Bodies this Operation is checked; because, if the Air should condense, there is nothing to succeed. It must therefore be tried in loose Bodies, as Sand and Powder; which, if they lie close, do of themselves gather Moisture².

The several Ways for converting Air into Water.

V O L. III.

I i

A

¹ Viz. Snow, or beaten Ice, and Salt, or other artificial Mixtures: among the strongest whereof is reckoned *Sal Armoniac* dissolved in Water; or, what is much stronger, Spirit of Salt, or Spirit of Nitre, poured upon Ice or Snow.

² The several Experiments here proposed, may seem not to reach the Point; which indeed is a capital Work, if understood of an actual artificial Change of proper elastic Air into the gross Body of Water. To understand the Author's Meaning, in this Particular, see the *Article AIR*; and for farther Light and Direction in the Affair, consult the *Articles ALTERATION, GOLD, PUTREFACTION, &c.* There are also some useful Particulars relating to this Purpose, in the Author's *History of Winds*; Sir Isaac Newton's *Queries*, at the End of his *Opticks*; Mr. Hales's *Vegetable Statics*; and Dr. Boerhaave's *Chemistry*, under the Chapters of *Air* and *Water*.

V.

*A first Draught for the particular History of VEGETABLES and VEGETATION.**Introduction.*

1. **V**egetables should be diligently enquired into, as being a principal Part of the third Day's Work ; the first *Producat* ; and of excellent and general Use for Food, Medicine, and many Mechanic Arts ^a.

2. HEADS of ENQUIRY.

ARTICLE I.

Of the Acceleration of Germination.

ARTICLE II.

Of the Retardation of Germination.

ARTICLE III.

Of the Melioration of Trees, Plants, and Fruits.

ARTICLE IV.

Of Compound Fruits and Flowers.

ARTICLE V.

Of the Sympathy and Antipathy of Plants.

ARTICLE VI.

Of rendering Fruits and Herbs medicinal.

ARTICLE VII.

Of Curiosities in Vegetation.

ARTI-

^a The Author has here bestowed considerable Pains ; and collected together a great number of Materials for the *physical History of Vegetation*. But what he delivers upon the Subject is not, perhaps, so valuable in itself, as for the Light and Direction it affords in executing the Design ; by discovering *Causes*, and raising *Axioms*. With this View he recommends several Experiments to be tried, that are directly levelled at the Investigation of *Causes* : which Particular being usually unobserved by the common Writers upon *Agriculture* and *Horticulture* ; they have often excepted to these *Experiments*, either as unsuccessful, or of little use ; without penetrating into the Design of the Author, who chiefly writes for such Philosophers as can learn as much from an unsuccessful Experiment, as from one that shall succeed ; and understand how to separate and concoct *Experience* into *Aphorisms*, *Axioms*, and sure *Rules* of future Practice : in which Light the *untried Experiments* here recommended, differ widely from those commonly practised by Gardeners ; as having a much nobler View. And certainly they are unacquainted with the Nature and Use of the *Sylva Sylvarum*, who do not perceive the Excellence of the *untried Experiments* therein recommended, above those that have been usually tried.

ARTICLE VIII.

Of the Degeneration of Plants, and their Transmutation into one another.

ARTICLE IX.

Of the Tallness, Lowness, and Artificial Dwarfing of Trees.

ARTICLE X.

Of the Rudiments and Excrecencies of Plants.

ARTICLE XI.

Of the Production of perfect Plants without Seed.

ARTICLE XII.

Of Exotic Plants.

ARTICLE XIII.

Of the Seasons of Plants.

ARTICLE XIV.

Of the Duration of Herbs and Trees.

ARTICLE XV.

Of the different Figures of Plants.

ARTICLE XVI.

Of the principal Differences in Plants.

ARTICLE XVII.

Of Composts and Helps for Ground.

ARTICLE XVIII.

Of the Relation between Plants and inanimate Bodies.

ARTICLE XIX.

Of the Relation between Plants and Animals.

ARTICLE XX.

Miscellaneous Experiments and Observations upon the Subject.

S E C T. I.

Of the Acceleration of Germination.

Growth accelerated by Hot-beds.

3. (1.) **W**E sowed, in a Hot-bed, *Turnip-feed, Radish-feed, Wheat, Cucumber-feed, and Pease*. The Bed was made of well-rotted Horse-dung, laid upon a Bank half a Foot high, and supported round with Planks; and, upon the Top, we threw sifted Earth, two Fingers deep. The Seed sown upon it, was first steeped, all Night, in Water mixed with Cow-dung. The Turnip-feed and Wheat, came up half an Inch above Ground in two Days, without any watering; and the rest came up the third Day. The Experiment was made in *October*: perhaps, in the Spring, the Acceleration might have been greater. Without this Help, the Seeds would have been four times as long in coming up. But there does not, at present, occur any profitable Use of this Experiment, unless for sowing of Pease; the Price whereof is much increased by coming early. It may be tried also with Cherries, Strawberries, and other Fruits which are dearest when early^o.

The Effects of different Steepings.

4. (2.) We steeped *Wheat* in Water mixed with Cow-dung; in Water mixed with Horse-dung; in Water mixed with Pigeon's dung; in human Urine; in Water mixed with powdered Chalk; in Water mixed with Soot; in Water mixed with Ashes; in Water mixed with Bay-salt; in Claret-wine; in Malmsey; and in Spirit of Wine. The Proportion of the Mixture was a fourth Part of the Ingredient to the Water; only of the Salt there was not above an eighth Part. The Urine, the Wines, and the Spirit of Wine, were without any Mixture of Water. The Time of the Steeping was twelve Hours; the Time of the Year, *October*. Along with these was also sown another Parcel of unsteeped Wheat; but watered twice a-day with warm Water: and some we sowed simple, to compare with the rest. The Event was, that the Grain steeped in the Mixtures of Dung, Urine, Soot, Chalk, Ashes, and Salt, came up within six Days: and those that, afterwards proved the tallest, thickest, and strongest, were, first, the Urine; then the Dungs; next the Chalk; next the Soot; next the Ashes; next the Salt; next the Wheat, unsteeped and unwatered; next that watered twice a-day with warm Water; and next the Claret-wine. So that the three last being slower than the ordinary Wheat of itself, this Culture proved rather prejudicial. As for those that were steeped in Malmsey, and Spirit of Wine; they came not up at all^p. This is a profitable Experiment,

^o The common Hot-beds seem to require some considerable Improvements; to make them produce strong and perfect, as well as quick and early. In order to improve them, enquire what is the most immediate or *material Principle* of Vegetation. or, if more Principles than one are concerned; let them all be duly regarded in the Preparation of *Artificial Composts*.

^p See *M. Homberg's Experiments upon Vegetation, in the French Memoirs*.

ment ; for most of the Steepings are cheap things : and the goodness of the Crop is a considerable point of Gain ; if the goodness thereof answer the earliness of coming up ; as probably it will ; both proceeding from the Vigour of the Seed. The Experiment should be tried in other Grain, Seeds, and Kernels ; for, perhaps, certain Steepings agree best with certain Seeds. It should also be tried with Roots, steeped for a long time : and in several Seasons of the Year ; especially the Spring ¹.

5. (3.) *Strawberries* being watered once in three Days, with Water where- in the Dung of Sheep, or Pigeons, has been infused, will come up early. And perhaps the same might hold in other Berries, Herbs, Flowers, Grains, or Trees. The Experiment therefore, tho common in Strawberries, is not yet brought into general Use. 'Tis a frequent Practice to help the Ground with Dung or Manure ; but to water it with Muck-water ², which seems more powerful, is not practised. Dung, Chalk, or Blood, seasonably applied, in Substance, to the Roots of Trees, hastens their Growth ; but without some Mixture of Water, or Earth, perhaps such Helps are too hot for Herbs ³.

Watering with an Infusion of Dung, recommended.

6. The preceding Means of promoting Germination, depend upon the goodness and strength of the Nourishment ; or the supporting and exciting the Spirits in the Plant, the better to attract it : of the latter kind, are the Experiments following. (1.) To plant Trees against a Wall to the South, or South-east Sun, hastens their Growth and Ripening. The South-east is found better than the South-west for this Purpose, tho the South-west be hotter ; because the heat of the Morning succeeds the cold of the Night ; and partly, because the South-west Sun is often too parching. (2.) So likewise the planting of them against a Chimney, where a Fire is kept, hastens their coming up, and ripening : and drawing the Boughs into a Room where there is a constant Fire, produces the same Effect ; as has been tried in Grapes ; which will, thus, come a Month earlier than otherwise ⁴. (3.) Another Means of accelerating Germination, is by making way for a ready Supply, and Attraction of the Nourishment ; whence, gentle digging and loosening, of the Earth about the Roots of Trees ; and the removing of Herbs and Flowers into new Earth, once in two Years, (for the new Earth is always looser) greatly promotes the thriving, and early coming of Plants. (4.) But the best Acceleration, in the Way of facilitating the Conveyance of the Nourishment, is that by Means of Water.

Means of quickening the Spirit, and promoting the Nutrition of Vegetables.

7. A

¹ The Farmers, in some Counties of *England*, now commonly steep their Seed-wheat in common Brine, or the Brine of their Pork-vats, to Advantage. But proper Trials of other useful Steepings are still wanting ; and should be directed from some Knowledge of the *Material Cause of Vegetation*.

² That is by suffering the Dung to steep in the Water, whereby a Tincture of its more soluble Parts will be gained ; and the more gross Matter fall to the Bottom. Perhaps such a Tincture may be too rich for certain Vegetables, or certain Beds ; unless made dilute, or used but seldom.

³ When used in too great plenty they prove prejudicial ; otherwise they greatly invigorate Trees that are old or decayed.

⁴ And yet prove excellent ; as I have seen ; particularly in *Holland*.

Roses growing
in Water.

7. A Standard of a Damask-rose, with the Root on, being set upright in an earthen Pan, full of fair Water, half a Foot deep in the Water; the Top rising more than two Foot above the Surface; and the Pan placed in a Chamber where no Fire was kept; within ten Days put forth a fair green Leaf; and some other little Buds, which made a Stand for above seven Days, without any Appearance of Decay or Withering. Afterwards the Leaf faded, but the young Buds sprouted on, and opened into fair Leaves, in three Months time; and continued so a while after, till upon Removal we ceased the Trial. But the Leaves were somewhat paler, and lighter coloured, than others of the same Kind. The first Buds appeared at the end of *October*; and, 'tis probable, if it had been Spring-time, the Standard would have shot with greater strength, and have grown on, to bear Flowers. By this means Roses might be set in the midst of a Pond; being supported by some Prop: which is matter of Pleasure, tho of small Use. The Experiment is the more strange, because a like Rose-standard being, at the same time, put into Water mixed with a fourth part of Horse-dung, yielded no Leaves; tho several Buds at the first, as the other did ^v.

Vegetables
growing in
Water only.

8. A *Dutch Flower*, with a bulbous Root, being, at the same time, placed wholly under Water, two or three Inches deep, sprouted in seven Days; and continued growing long after. A Beet-root, a Borrage-root, and a Radish-root, all their Leaves being cut almost close, were treated in the same manner; and had fair Leaves within six Weeks: and so continued till the end of *November* ^v.

A double Ad-
vantage in ac-
celerating
Roots, &c.

9. If Roots, Pease, or Flowers, may be accelerated in their Growth and Ripening, a double Profit will attend it; because of the advanced Price they bear when they come early; and again, because of the Quickness of their return: thus, in some Grounds which are strong, Radishes, for instance, will come in a Month; that, in other Grounds, would not come in two: and so make double Returns.

Wheat not
growing in
Water.

10. Wheat being put into Water, sprung not at all; whence, probably, there is required some Strength and Bulk in the Body put into Water, as in Roots: for Grain, or Seeds, will mortify by the Cold of the Water. But a little lying casually under the Pan, and being somewhat moistened by the Exudation thereof, tho it appeared mouldy, it was, in six Weeks, sprouted half a Finger.

The Doctrine
of the preced-
ing Experi-
ments.

11. It should seem, by these *Instances*, that in point of Nourishment, Water is a capital Thing; and, that the Earth does but keep the Plant upright; and preserve it from too much Heat or Cold ^w: which is comfortable Doctrine for great Drinkers. It proves also, that Drinks incorporated with Flesh, or Roots, will nourish more easily than Meat and Drink, taken separate ^x.

12.

^v No Conclusion can be safely drawn from this Experiment, for want of knowing whether there were no Difference in the Roots of the two Standards, or other Circumstance.

^w For the Reason why Water alone may nourish Plants, see Dr. Woodward's *Experiments upon Vegetation*, in the *Philosophical Transactions*. Numb. 253.

^x A farther Scrutiny, and more particular Experiments, seem requisite, before any *Axiom* can be formed upon this Head. See the Chapter of *Water* in *Boerhaave's Chemistry*.

* See the *Article FOODS*.

12. (5.) The *Housing of Plants* may contribute both to the Acceleration and Production of Flowers and Plants, in the colder Seasons : and as we house the Exoticks of hot Countries ; viz. Lemmons, Oranges, and Myrtles, to preserve them ; so we may house our Natives, to forward them, and make them thrive in the cold Seasons. And thus we may have Violets, Strawberries, and Pease all Winter ; provided they be sown, or removed, at proper Times ⁷. This Experiment is referable to the cherishing of the Spirit of the Plant by warmth, as well as housing their Shoots, &c. So that the Means of accelerating Germination, are, in particular, eight ² ; and, in general three ³.

The Advantages of housing Plants.

SECT. II.

Of the Retardation of Germination.

I. **T**O make Roses, or other Flowers, come late, is an Experiment of Pleasure. The Ancients highly esteemed the *Rosa Sera* : and indeed the *November Rose* is the sweetest ; as having been less exhaled by the Sun. The Means are these ; viz. (1.) To cut off their Tops, immediately after they have done bearing ; whence they will come again the same Year about *November*. They will not come just on the cut Tops ; but upon those Shoots, which were a kind of Water Boughs : because the Sap, that would otherwise have fed the Top, will now divert to the Side-shoots ; and make them bear, tho later. (2.) To pluck off the Buds when newly knotted ; for then the Side-branches will bear : cutting off the Tops, and plucking off the Buds, having the same Effect, as to Retention of the Sap for a time ; and the diverting it to the Roots, that were not so forward. (3.) To cut off some few of the top Boughs in the Spring, and suffering the lower to continue growing on : for the Shoots help to draw up the Sap more strongly ; as in the polling of Trees, 'tis usual to leave a Bough or two on the Top, to draw up the Sap. And 'tis reported, that by Grafting upon the Bough of a Tree, and cutting off some of the old Boughs, the new Cions will perish ^b. (4.) To lay the Roots bare for some few Days about *Christmas* : which stops the ascent of the Sap for a time ; tho it is afterward set free, by covering the Root again with Earth ; whence the Sap mounts the later ^c. (5.) To remove the Tree a Month before it buds : for some time is required after the Removal, to resettle it, before it can attract the Juice ; and that time being lost, the Blossom must needs come later. (6.) To graft Roses in *May*, which Gardeners seldom do till *July* ; and then they bear not till the next Year : but grafted in *May*, they will bear late the same Year. (7.) To

The several Means of making Flowers come late.

⁷ Due regard must be had, that the hot and dry Air of the Green-house does not exhale their aqueous Parts too fast ; and that a proper Supply of Air and Water be given them.

² See above, § 6, &c.

³ See above, § 3, 4, 5, 6.

^b This appears contrary to common Experience.

^c But does this cause the Trees to bud or bear later afterwards ?

- (7.) To gird the Body of the Tree with Pack-thread ; for this also, in some degree, restrains the Sap, and makes it ascend later and slower ^d.
 (8.) To plant them in a Shade, or a Hedge ; for thus they are retarded, partly by want of Sun, and partly by want of Nourishment, on account of the Hedges ^e. These Means may be practised, both upon Trees and Flowers *mutatis mutandis* ^f.

S E C T. III.

Of the Melioration of Trees, Plants, and Fruits.

*The Advan-
tages of laying
Stones to the
Roots of Trees.*

1. **T** HIS Matter of Experience, that a Heap of Flint, or Stone, laid about the Bottom of a wild Tree, as an Oak, Elm, Ash, &c. makes it prosper twice as much as without it. The Cause is, that it retains the Moisture at any time falling upon the Tree ; suffers it not to exhale by the Sun ; and also defends the Tree from cold Blasts, and Frosts, as it were in a House ^g. Perhaps too there is somewhat in keeping it steady at first. Let it be tried, if laying Straw to some height about the Body of the Tree, will not make it come forwards. For tho the Root affords the Sap, 'tis the Body that must attract it. But if Stones be laid about the Stalks of Lettuce, or other Plants that are soft, the Roots will be over-moistened, so that the Worms will eat them.

*How Trees are
to be stirred
and cut, to
make them
thrive.*

2. A Tree, at the first setting, should not be shook till it has fully taken Root : whence some fix little Forks about the Bottom of their Trees, to keep them upright ^h ; but, after a Year's rooting, shaking does the Tree good, by loosening the Earth, and perhaps by exercising, as it were, and stirring the Sap. Generally, the cutting away of Boughs, and Suckers, at the Root and Body, makes the Tree grow tall ; as the polling and cutting off the Top, makes them spread and grow bushy.

*To hasten Cop-
pice-wood.*

3. 'Tis reported, that to hasten Coppice-woods the Way is, to take Willow, Sallow, Poplar, or Alder, of seven Years growth ; and set them a-slope, a reasonable Depth under ground : when, instead of one Root, they will strike many ; and so carry more Shoots upon a Stem ⁱ.

4. To

^d Will not the Sap rise in plenty, tho the Tree were strongly girded ?

^e But will the Rose-Trees thus planted bear at all ; for want of the Sun, and proper Nourishment ?

^f How many of these probable Means of procuring late Flowers will stand good, after the Method of Rejection is practised upon them ? Let it constantly be observed, that Experiments well directed, afford as much Light when they fail, as when they succeed. But it must be the Philosopher, not the Gardener, who reaps this Fruit.

^g One of the greatest Inconveniences of this Practice is affording a harbour to Vermin ; which might thus prove destructive to young Trees.

^h Gardeners generally fasten their new planted Trees to a Stake with a Hay-band, to prevent their being rocked by the Wind ; and continue them thus bound for some Years, if they desire them to grow strait.

ⁱ Is this verified by Experience ?

4. To have many new Roots of Fruit-trees; bend a low Tree, lay all its Branches flat upon the Ground; cast Earth upon them; and every Twig will take Root^k. This is a very profitable Experiment in costly Trees; for thus Boughs will make Stocks without Charge. Try it in Apricots, Peaches, Almonds, Cornelians, Mulberries, Figs, &c. The like is constantly practised with Vines, Roses, Musk-roses, &c.

To multiply
Roots in
Fruit-Trees.

5. From May to July, peel off the Bark of any Bough, for three or four Inches; cover the bare place, somewhat above and below, with Loam, well tempered with Horse-dung; binding it fast down; then cut off the Bough about *Allballon-tide*, in the bare place; set it, and 'twill grow to be a fair Tree. The Cause may be, that stripping off the Bark keeps the Sap from descending, towards Winter; and so continues it in the Bough. Perhaps also, the Loam and Horse-dung applied to the bare place, moisten, cherish, and make it more apt to put forth the Root. And this may prove a general Means to keep up the Sap of Trees in their Boughs, for other Purposes^l.

To convert
Boughs into
Trees.

6. It has been practised in Trees that shew fair, yet do not bear, to bore a Hole thro' the Heart of them, to render them fruitful: in which case, the Tree before might be too replete, and oppressed with its own Sap; for Repletion is an Enemy to Generation. It has also been practised in barren Trees, to cleave two or three of the chief Roots, and put a small Pebble into the Cleft, to keep it open; which makes the Tree bear: for the Root, as well as the Body of a Tree, may be Bark-bound, and not keep open, unless somewhat be put into it^m.

To render
barren Trees
fruitful, by
opening the
Body and
Root.

7. 'Tis usual to set Trees that require much Sun, upon South Walls; as Apricots, Peaches, Plumbs, Vines, Figs, and the like. This has a double Convenience; viz. the heat of the Wall by Reflexion; and the preventing the Shade: for when a Tree grows round, the higher Boughs over-shadow the lower; but when spread upon a Wall, the Sun comes alike, both upon the upper and lower Branchesⁿ.

To meliorate
Fruits by
South Walls;

8. It has also been practised, to strip off some Leaves from the Trees so spread, that the Sun may come the better upon the Boughs and Fruit^o. A Tree has likewise been set upon the North-side of a Wall to a small height, then drawn thro' the Wall, and spread upon the South-side: that the Root and lower part of the Stock might enjoy the freshness of the Shade; and the upper Boughs and Fruit the benefit of the Sun. But it succeeded not; because the Root requires some cherishing from the Sun, tho' under the Earth,

The Root of a
Tree placed on
a North, and
the Boughs on
a South Wall.

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K k

as

^k Is this Treatment successful in Trees of all kinds, or only in some?

^l The descending of the Sap in Trees, has been peremptorily denied by Gardeners: but for a full Account of this Matter consult the *Philosophical Transactions*; *French Memoirs*; and Mr. Hales's *Vegetable Statics*.

^m These Experiments are, in some Cases, found to answer the End proposed; but they seem no general Methods of rendering barren Trees fruitful; each requiring a suitable Remedy according to the particular Cause of its Barrenness.

ⁿ This Method of Planting against a South Wall, is now extended to various Fruit-trees; and found eminently serviceable.

^o This stripping off the Leaves of Fruit-Trees, is observed to hasten the ripening; but to stifle the growth of the Fruit: for too much Sun puts a Period to Growth; or ripens before the time.

as well as the Body; and the lower part of the Body more than the upper, as we find in compassing a Tree below with Straw.

*The Advantage
of low Trees.*

9. The lowness of the Fruit boughs makes the Fruit greater, and causes it to ripen better; for we always see in Apricots, Peaches, or Melo-cotones upon a Wall, the largest Fruit is towards the bottom. And in *France*, the Grapes that make the Wine, grow upon low Vines, bound to small Stakes; whilst the rais'd Vines, in Arbors, only make Verjuicer. 'Tis true, in *Italy*, and other Countries, where the Sun is hotter, they raise them upon Elms and Trees; but I conceive, that if the *French* manner of planting low, were practised there, the Wines would be stronger and sweeter: But 'tis more chargeable on account of the Supporters. It were proper to try, whether a Tree grafted somewhat near the Ground, with the lower Boughs only maintain'd, and the higher continually pruned off, would not make a larger Fruit.

*To produce
plenty of
Fruit.*

10. To have plenty of Fruit, the way is, to graft, not only upon young Stocks, but upon several Boughs of an old Tree; for these will bear much Fruit: whereas, if you graft but upon one Stock, the Tree can bear but little.

*Digging about
the Roots of
Trees recom-
mended.*

11. To dig yearly about the Roots of Trees, as a means both to accelerate and meliorate Fruits, is only practised in Vines; but if transferr'd to other Trees and Shrubs, I conceive it would improve them likewise. A Fruit-Tree being blown up, almost, by the Roots, and set again; it bore exceedingly the next Year. This seems owing to the loosening of the Earth, which refreshes any Tree; and should be practised more than at present in Fruit-Trees: for Trees cannot be so commodiously removed into new Ground, as Flowers and Herbs.

*To revive old
Trees.*

12. To revive an old Tree, dig about its Roots, and apply new Mould thereto. We see that Draught-Oxen put into fresh Pasture, get new and tender Flesh: and in all Cases, better Nourishment than ordinary helps to renew; especially if it be not only better, but differing from the former.

*To make large
Roots.*

13. If an Herb be cut off from its Roots in the beginning of Winter, and the Earth be trod and beat down hard with the Foot and Spade, the Roots will be very large in Summer: for the Moisture being thus kept from rising

* On Account, perhaps, of the Heat reflected from the Earth; which reaches the lower Boughs strongest.

† But is not this Difference chiefly owing to the Nature of the two several Species?

‡ This is found to answer, when the Branches of a Tree are bent downwards, and thrown along a South Wall.

§ This is also a Method of producing Fruit quick, as in the first or second Year; if the Grafts be from good Bearers. And hence we have an excellent way of converting old Trees to Profit; by letting them stand, instead of cutting them down for Fewel, and planting new, which will be long before they attain their Growth.

¶ This Expedient of digging about the Roots of Trees, is chiefly practised in stiff and cold Ground, and after the Trees have stood for some Years; lest it might otherwise subject them to be blown down by the Winds.

‡ The Soil may sometimes be too rich of itself; and then the addition of a poorer Kind is an Amendment.

rising in the Plant, stays longer in the Root, and so dilates it. And Gardeners commonly tread loose Ground, after sowing Onions, Turnips, &c. *Panicum* laid below and about the bottom of a Root, will cause it to grow excessively; for being itself of a spongy Substance, it attracts the moisture of the Earth, and so feeds the Root. This is of principal Use for Onions, Turnips, Parsnips, and Carrots.

14. The shifting of Ground is a means to meliorate Trees and Fruits; *Melioration by Shifting.* but with this Caution, that all Things prosper best when advanced from worse to better *. Thus Nurseries of Stocks should be in a more barren Ground, than that whereto they are removed: and all Grasers remove their Cattle from poorer Pasture to richer. So hardiness in Youth prolongs Life; because it leaves the Body improvable in Age: and even in Exercises, 'tis good to begin with the hardest, as dancing in thick Shoes, &c.

15. Hacking of Trees in their Bark, both right down and across, so as *Slitting the Bark of Trees.* to make rather Slits than continued hacks, is highly serviceable to Trees; prevents their being Bark-bound, and kills the Moss †.

16. Shade conduces to render some Plants large and prosperous, more *Shade useful to some Plants.* than the Sun; as in Straw-berries, Bays, &c. And therefore to sow Borage-seed thin among Straw-berries, will make the Fruit under the Borage-leaves far larger than their Fellows †. And Bays should be planted to the North, or defended from the Sun, by a Hedge-row: and when you sow the Berries, weed not the Borders for the first half Year; because the Weeds afford a proper Shade.

17. To increase the Crops of Vegetables, we must not only increase the Vigour of the Earth, and of the Plant; but also preserve what would otherwise be lost. Thus the late Trial to set Wheat, is now left off, because of the Trouble and Pains it required: yet there is much saved by *Setting, in Comparison of Sowing;* as keeping the Seed from being eat up by the Birds, and avoiding the shallow lying of it, whereby much of what is sown, cannot take Root. *Considerations for augmenting the Crops of Vegetables.*

18. 'Tis reported, that if Nitre be mixed with Water, to the thickness of Honey, and after a Vine is cut, the Bud be anointed therewith, it will sprout within eight Days. If the Experiment be true; the *Cause* may lie in the opening of the Bud, and contiguous Parts, by the Spirit of the Nitre; for Nitre is the Life of Vegetables †. *Nitre the Principle of Vegetation.*

K k 2

19. Put

* This Caution admits of an Exception, where the Soil was too rich; in which Case removing to a poorer, would render the Tree more healthy and fruitful. Many of the *Rules of Medicine* seem to have place in Vegetables.

† This is chiefly practised in Trees of some years Growth; and found very useful, especially when they are already Bark-bound.

‡ But then the Shade must not be large. Perhaps Straw-berries are best delighted with a mixture of Sun and Shade.

§ How far this may be true, is not perhaps sufficiently shewn; notwithstanding the Experiments of Sir Kenelm Digby, and M. Homberg. Consult Mr. Evelyn's *Sylva*; the *Philosophical Transactions*; the *French Memoirs*; and Dr. Stahl's *Philosophical Principles of Chemistry*: but a proper Set of accurate Experiments seem still wanting in this View.

*Seeds sown in
a Sea-Onion.*

19. Put any Seed, or the Kernels of Apples, Pears, Oranges, the Stone of a Peach, a Plumb, &c. into a Squill ; and they will come up much earlier than when sown in the Earth itself. This I conceive is a kind of grafting in the Root ; for as the Stock yields a better prepared Nourishment to the Graft than the crude Earth ; so does the Squill to the Seed. And I suppose the same would succeed, by putting Kernels into a Turnip, or the like ; only that the Squill is more vigorous and hot. It may be tried also, by putting Onion-feed into an Onion ; which thereby, perhaps, will bring forth larger and earlier ^a.

*Fruits seem ri-
pen'd by prick-
ing.*

20. Tho' pricking of Fruit in several places, when almost full grown, and before it ripens, has been practis'd with Success, to bring it sooner to Maturity. The biting of Wasps or Worms upon Fruit, causes it to ripen manifestly quicker. 'Tis reported, that Sea-weed, put under the Roots of Coleworts, and other Plants, will forward their Growth. The Virtue, no doubt, has relation to Salt, which greatly promotes Fertility ^b.

*To bring Cu-
cumbers early.*

21. It has been practis'd to cut off the Stalks of Cucumbers, immediately after their bearing, close by the Earth ; and then to throw a quantity of Mould upon the remaining Plant : which makes them bear fruit the ensuing Year, long before the ordinary time. The Cause may be, that the Sap goes down the sooner, and is not spent in the Stalk or Leaf, remaining after the Fruit. The dying of the Roots of annual Plants in the Winter, seems partly owing to the profusion of Sap in forming the Stalk and Leaves ; which being prevented, they will super-annuate, if they stand warm.

*The Use of
plucking off
some Blossoms
from Trees.*

22. To pluck off many of the Blossoms from a Fruit-Tree, makes the Fruit fairer : the Sap thus having less to nourish. And 'tis commonly observed, that if some Blossoms be not plucked off the first time a Tree blows, it will blossom itself to death ^c.

*A Trial of
plucking off all
the Blossoms
recommended.*

23. It were proper to try the Effect of plucking off all the Blossoms from a Fruit-Tree ; or the Acorns, Chesnut-Buds, &c. from a wild Tree ; for two years together. I suppose the Tree would either yield Fruit the third Year, larger, and in greater plenty ; or else, the larger Leaves, in the intermediate Years, because of the Sap here treasured up ^d.

*Whether Plants
grow quicker
when watered
with warm
Water.*

24. It has been generally received, that a Plant watered with warm Water, will come up sooner and better, than when water'd with cold Water, or Showers. But our Experiment of watering Wheat with warm Water did not succeed ; perhaps because made too late in the Year, viz. the end of October : for the Cold then coming upon the Seed, after being render'd more tender by warm Water, might check it.

25. No

^a These Experiments appear probable ; but how they answer upon Trial, should be particularly observed and recorded. They seem better fitted for the Use of Philosophers than Gardeners ; and therefore perhaps have not been fully prosecuted.

^b See more to this purpose under the Article MATURATION.

^c Especially if the Tree be lately planted, and the Root be weak.

^d Has this Experiment been duly made ?

25. No doubt, but grafting generally meliorates the Fruit ; because the Nourishment is better prepared in the Stock, than in the crude Earth ^e. Yet some Trees are said to come up stronger from the Kernel, than from the Graft ; as the Peach and Melo-cotone : perhaps because those Plants require a Nourishment of greater Moisture. And tho the Nourishment of the Stock be finer and better prepared ; yet 'tis not so moist and plentiful as that of the Earth : and indeed we find those Fruits very cold in their Nature.

The Melioration of Fruit by Grafting.

26. It has been received, that a smaller Pear, grafted upon a Stock bearing a larger Pear, will become large : but I judge that the Cions will govern. Yet, probably, if you can get a Cion to grow upon a Stock of another kind, that is much moister than its own, it may make the Fruit larger ; because it will yield more Nourishment ; tho perhaps coarser. But Grafting is generally practised upon a drier Stock ; as the Apple upon a Crab ; the Pear upon a Thorn, &c. Yet 'tis reported, that, in the *Low-Countries*, they will graft an Apple-Cion on a Colewort-Stock, and it shall bear a great flaggy Apple ; the Kernel whereof if set, will prove a Colewort, not an Apple. It were proper to try whether an Apple Cion will prosper, when grafted upon a Sallow, a Poplar, an Elder, an Elm, or a Horse-Plumb ; which are the moistest of Trees. I have heard it has been tried with Success upon an Elm ^f.

27. 'Tis manifest by Experience, that Flowers removed, grow larger ; because Nourishment is more obtained in loose Earth. Perhaps also, frequently to re-graft the same Cions, may make the Fruit larger ; as if a Cion were grafted upon a Stock the first Year ; then cut off and grafted upon another Stock the second Year ; and so the third or fourth ; at last permitting it to rest ; to try if when it bears, it will yield a larger Fruit ^g.

Transplantation and Re-grafting.

28. If a Fig-tree produce better Figs, for having its Top cut off when its Leaves begin to sprout, the Cause is plain ; the Sap now having fewer Parts to feed, and a less way to mount : but perhaps the Figs will come somewhat later. The same may also be tried in other Trees ^h.

Melioration of Figs, by cutting off the top of the Tree.

29. 'Tis reported, that Mulberries will be fairer, and the Trees more fruitful, if you bore their Trunks thro' in several places, and force into the Apertures, wedges of some hotter Tree ; as Turpentine, Mastick, Guaiacum, Juniper, &c. perhaps because the adventitious Heat revives the native Juice of the Tree. 'Tis also reported, that Trees will grow larger, and bear better

Melioration of cold Fruit, by Wedges of hot Trees ; and rich Composts.

^e Is this Reason just ? Do not the Branches of an ungrafted Tree, receive their Nourishment from the Stock, as well as the Graft does ? Or does not the Advantage of Grafting depend upon the Nature of the Graft, and its being chose from a better Tree than that whereon it is grafted ?

^f The Business of Grafting and Inoculation require a strict physical Enquiry ; and a suitable variety of judicious and well calculated Experiments.

^g This is said to have been tried without Success : the Grafts still retaining their original Nature.

^h If this be practised on young Trees ; it makes them throw out large strong Shoots, that are apt to continue for a Season or two unfruitful.

better Fruit, by having Salt, Wine-Lees, or Blood applied to the Root; these Things being more forcible than ordinary Composts ⁱ.

Melioration of Herbs by Potting, and watering with Salt-Water.

30. Herbs will become tenderer and fairer, if taken out of their Beds, when newly come up; and removed into Pots with better Earth. Coleworts are reported to prosper exceedingly, and to be better tasted, if sometimes water'd with Water mix'd with Salt; or much rather with Nitre; the Spirit whereof is less heating ^k.

Steeping Seeds in Atilk.

31. 'Tis said, that Cucumbers will prove more tender and excellent, if their Seeds be steeped a little in Milk: perhaps because the Seed being mollified with the Milk, is too weak to attract the grosser Juice of the Earth, and so takes only the finer. The same Experiment may be made with Artichocks, and other Seeds, in order to take away either their Flashiness or Bitterness.

To meliorate Cucumbers.

32. 'Tis reported, that Cucumbers will be less watry, and more Melon-like, if the Pit where they grow be half fill'd with Chaff; or small Sticks; and Earth be thrown upon them: for Cucumbers extremely affect Moisture; and are apt to over-drink themselves; which this Procedure prevents ^l.

Melioration by Terebration and Tapping.

33. The Terebration of Trees not only makes them prosper, but also renders the Fruit sweeter: for notwithstanding the Perforation, they may receive sufficient Nourishment; yet no more than they can well digest; and at the same time sweat out the coarsest and unprofitable Juices, as in Animals; which by moderate Feeding, Exercise, and Sweat, attain the soundest Habit of Body. And as Terebration meliorates Fruit; for the like Reason does the Bleeding of Plants, as by pricking the Vine, or other Trees, after they are somewhat grown; and thus letting out their Gums or Tears: tho' this be not to continue, as in Terebration; but to be done only at certain Seasons ^m. And it is reported that by this means, Bitter Almonds have been turn'd into Sweet.

Melioration by Rezardation of the Sap.

34. 'Tis observed, that all Herbs become sweeter, both in Smell and Taste, if, when grown up some seasonable time, they be cut; and the later Sprout be chose. The Reason may be, that the longer the Juice continues in the Root and Stalk, the better it is concocted. For one chief Cause why Grain, Seeds, and Fruits, are more nourishing than Leaves, is the length of Time they require to ripen. It were not amiss to keep back the Sap of Herbs, by some proper means, till the end of Summer; whereby perhaps they will become more nourishing ⁿ.

35. As

ⁱ These Materials being extremely rich, are to be sparingly used; and, perhaps, chiefly in the Winter.

^k See M. Homberg's Experiments upon Vegetation, in the *French Memoirs*.

^l Does this Experiment succeed upon Trial?

^m For the Method and Uses of Tapping Trees, see certain Papers in the *Philosophical Transactions*; particularly N 43, 48, 57, 58, 68.

ⁿ This is an Experiment of Consequence; and requires that the best means should be thought of for trying it; whether by Cold, Ligature, want of Moisture, or otherwise.

35. As grafting generally advances and meliorates Fruits above what they are when produced from Stones, Seeds or Kernels ; because the Nourishment is better concocted ; so in Grafting itself, for the same Cause, the choice of the Stock contributes much ; provided it be somewhat inferior to the Cion : otherwise it obstructs. The grafting of Pears and Apples upon a Quince is highly commended °.

The Stock in Grafting to be poorer than the Cion.

36. Besides the abovementioned means for meliorating Fruits, it has been tried, that a mixture of Bran and Swine's-Dung, or Chaff and Swine's-Dung, laid to rot for a Month, greatly nourishes and supports Fruit-Trees †.

Melioration by Composts.

37. 'Tis said, that Onions grow larger, if, being taken out of the Earth, they are laid to dry for twenty days, and then set again ; and yet more, if the outermost Coat be taken off all over.

Melioration of Onions.

38. 'Tis said, that if the Bough of a low Fruit-Tree newly budded, be gently drawn, without hurting it, into an earthen Pot, perforated at the bottom to receive it ; and then the Pot be cover'd with Earth ; it will yield a very large Fruit within the Ground. Which Experiment is no more than potting of Plants without removing ; and leaving the Fruit in the Earth. The like, *they say*, may be effected by an empty Pot, without Earth in it, put over a Fruit, supported as it hangs upon the Tree ; and the better if some few Holes be made in the Pot. In this Experiment, besides defending the Fruit from the Extremity of the Sun or Weather, some assign for a Reason, that the Fruit coveting the open Air and Sun, is invited by those Holes to spread and approach as near them as it can ; and thus enlarges in Magnitude §.

Melioration by potting of Fruit.

39. All Trees in high and sandy Grounds are to be set deep ; and in watry Grounds more shallow. And in the removal of Trees, especially Fruit-Trees, care should be taken that their Sides be set North and South, &c. as they stood before †.

Trees when transplanted to retain their former Position.

40. Timber-Trees in a Coppice, grow better than in an open Field ; because they spread not so much, but shoot up in height ; and chiefly because they are defended from too much Sun and Wind, which check the Growth of all Fruit. And thus, no doubt, Fruit-Trees, or Vines, set against a Wall to the Sun, between Elbows or Buttresses of Stone, ripen the Fruit better than a plain Wall ‡.

Trees grow best against buttress'd Walls.

41. 'Tis

° See above, § 25, 26.

† In the time of rotting, a considerable Heat is generated, which might prove unsuitable to certain Trees ; but by the Operation, the whole is turn'd into an uniform kind of Mould. The History of Vegetation requires a previous Enquiry into the Nature, Office, and Use of Putrefaction.

‡ Tho a large Fruit may be thus procured ; yet will it be so well ripen'd, as another more expos'd to the Sun ?

§ Do Gardeners find any Necessity for observing this Rule ? Or is any Advantage certainly found in observing it ?

¶ On account of the Sun's Rays reflected upon the Fruit, and the general Heat thus thrown by the Stone-Elbows upon the Trees.

*Potting of
Roots.*

41. 'Tis said, that if Potato Roots be set in a Pot fill'd with Earth, and the Pot be set in the Ground two or three Inches deep, the Roots will grow larger than ordinary. The Cause may be, that having Earth enough within the Pot to nourish them; and being stopped by the bottom of the Pot from shooting their Strings downward; they grow more in Breadth and Thickness. And perhaps all Seeds or Roots potted, and so set in Earth, will prosper better.

*Covering them
high with
Earth in Win-
ter.*

42. The cutting off the Leaves of Radish, or other Roots, in the beginning of Winter, before they wither, and covering again the Root something high with Earth, will preserve the Root all Winter; and make it larger the following Spring. So that there is a double use of this cutting: for in Plants, where the Root is esculent, as Radish and Parsnip, it will make it greater: and so it will the heads of Onions^t. And where the Fruit is esculent, it will by strengthening the Root make also the Fruit larger.

*To procure Fo-
liage to Trees,
by Grafting.*

43. 'Tis an Experiment of great pleasure, to make the Leaves of shady Trees larger than ordinary. It has been tried, that a Cion of a Weech-Elm, grafted upon the Stock of an ordinary Elm, will put forth Leaves almost as broad as the brim of a Hat. And 'tis very likely, that as in Fruit-Trees the Graft makes a larger Fruit; so in Trees that bear no Fruit, it will make the Leaves larger. It should therefore be tried in such Trees as Birch, Asp, Willow; and especially the shining Willow call'd Swallow-Tail, for the Pleasure of its Leaf^v.

*The Causes of
Barrenness in
Trees.*

44. The Barrenness of Trees by Accident, besides the weakness of the Soil, Seed or Root, and the injury of the Weather, proceeds either, (1.) from their being overgrown with Moss; (2.) Bark-bound; (3.) planted too deep; or, (4.) from the Sap going too much into the Leaves: For all which there are Remedies mention'd above^v.

S E C T. IV.

Of Compound Fruits and Flowers.

*The Production
of new Spe-
cies of Vege-
tables recom-
mended.*

1. **I**N Animals that have Male and Female, there are several kinds of Copulation, productive of compounded Creatures: thus the Mule is generated betwixt the Horse and the Ass, &c. The Compounding or Mixture of Kinds in Plants is not known; which, however, if possible, were a Thing more at Command than in living Creatures; where Generation requires

^t 'Tis the common Practice to Plant Salary in Trenches, and cover it high with Earth, some time afterwards; in order to procure the greater Length of the white esculent Root.

^u The Graft being taken from such Trees as afford the greatest Foliage, and a proper Stock made Choice of.

^v There may perhaps be many other Causes of Barrenness in Trees, besides those here enumerated; as Blasts, Insects, Cold, Wet, &c. all which require their particular Remedies.

quires a voluntary Motion. This would therefore be a capital Experiment in Vegetation, if discover'd: for thus we might have great variety of Fruits and Flowers hitherto unknown. Grafting does not produce this Effect; as only mending the Fruit, or doubling the Flowers, &c. without making any new Kind. For the Cion constantly over-rules the Stock.

2. It is *anciently deliver'd*, that two Twigs of different Fruit-Trees, being flatted on the opposite Sides, then bound close together, and set in the Ground, will come up in one Stock; yet put forth their several Fruits without commixture in the Fruit. Where note, that Unity of Continuance is easier to procure, than Unity of Species. It is reported also, that Vines of red and white Grapes, being set in the Ground, and the upper Parts being flatted and bound close together, will yield Grapes of several Colours, within the same Grape; but the more after a Year or two: the Unity, as it seems, growing more perfect. And it will also contribute, if from the first uniting, they be often watered; *for all Moisture promotes Union*. It is also prescribed to bind the Bud as soon as it comes forth, as well as the Stock, at least for a time.

*Experiments
for compound-
ing of Fruits.*

3. *They report*, that different Seeds, wrapped in a Cloth, and laid in Earth well dunged, will rise contiguous Plants; which being afterwards bound together, their Shoots will incorporate: and the like is *said* of Kernels put into a Bottle with a narrow Mouth, and fill'd with Earth. So again, *they say*, that young Trees, of several Kinds, set contiguous, without any binding, and very often water'd in fruitful Ground, will, thro' the very Luxury of the Trees, incorporate and grow together: which seems a more likely means; because the binding hinders the natural swelling of the Trees, which, unite the better whilst in Motion.

SECT. V.

Of the Sympathy, and Antipathy, of Plants.

1. **T**HERE are many received Traditions, about the Sympathy and Antipathy of Plants; some thriving best when they grow near others, which is imputed to Sympathy; and some worse, which is imputed to Antipathy.

*The Sympathy
and Antipathy
of Plants ex-
plained of At-
traction.*

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* Have the proper Experiments for this purpose been hitherto tried, with the *Farina Facundans* of Flowers, &c? See the *French Memoirs*, for the Year 1711, &c.

* These Experiments seem to favour more of Imagination than Practice.

† Tho Experiments of this kind, so slightly recommended, either by Reason or Authority, may perhaps scarce deserve to be tried; yet they have this Use, that they shew distress; and should excite the Industry of Philosophers to invent better for the Purpose. Let the Means of Generation in Plants be once exactly discover'd; and Experiments for compounding or mixing of their Species, will arise of themselves. Let particular Enquiry be made into the Fact deliver'd in the *Philosophical Transactions*, N^o 29. pag. 553. of the Orange Trees at Florence, that bear a Fruit, half Citron, half Orange; and are propagated by Engrafting. The Relation seems in a particular manner confirm'd, illustrated and explained, N^o 114. pag. 313. of the same Transactions.

to Antipathy. But these are idle and ignorant Conceits, that forsake the true *indication of Causes* ; as most Experiments do concerning Sympathies and Antipathies ². Plants have no such secret Friendship, or Hatred ; and to call it Sympathy and Antipathy, is quite mistaking the Thing ; their Sympathy being an Antipathy, and their Antipathy a Sympathy : for when ever one Plant attracts such a particular Juice from the Earth, as qualifies the remaining for another Plant, there Proximity does good ; because the Nourishment of the two Plants are contrary : and where two Plants draw the same Juice, there growing near together does hurt ; because the one thus defrauds the other.

Whence Plants become unfriendly to each other.

2. First therefore, the Plants that attract much Nourishment from the Earth, and so exhaust it, prejudice all Things that grow near them ; thus great Trees, especially Ashes, and such as spread their Roots near the Surface, are pernicious to other Plants ³. So the Colewort is not an Enemy to the Vine only ; but to any other Plant : because it strongly attracts the fattest Juice of the Earth ⁴. And if it be true, that the Vine, when it creeps near the Colewort will turn aside ; this may happen, because it there finds worse Nourishment : for tho the Root be where it was, yet I suspect the Plant will bend as it nourishes.

Whence friendly.

3. Where Plants are of different Natures, and attract different Juices, there the one being set by the other is of Service : as Rue prospers and becomes stronger ; if set by a Fig-tree : which may proceed from the Extraction of a contrary Juice : the one drawing Juice fit to become sweet, the other bitter. So, *they say*, that a Rose set by Garlick is sweeter : which likewise may happen, because the more fetid Juice of the Earth goes into the Garlick, and the more odorate into the Rose ⁵.

Certain Flowers peculiar to Corn Fields.

4. 'Tis manifest, that certain Corn-flowers seldom or never grow in other places, unless they are set, but only among Corn : as the Blue-bottle, a kind of yellow Mary-gold, the wild Poppy, and Fumitory. Nor can this proceed from the Culture of the Ground, by plowing or furrowing ; as some Herbs and Flowers will grow but in Ditches new cast up ; for if the Ground lie fallow and unfown, they will not come : whence it should seem to be the Corn that qualifies the Earth, and prepares it for their Growth ⁶.

Trials recommended for meliorating the Tastes and Odours of Vegetables.

5. If the foregoing Observation holds, it is of great Use for meliorating the taste of Fruits, esculent Herbs, and the scent of Flowers. For if the Fig-tree makes the Rue stronger and bitterer ; Rue plentifully planted about the Fig-tree, may make the Fig sweeter. And as the Tastes that offend in Fruits,

² See the *Article SYMPATHY*.

³ Especially if besides drawing away their Nourishment, they also over-shade such Plants.

⁴ Is there certainly found to be an Appetite of Election in Plants, whereby they attract one particular Juice of the Earth, and refuse another ? Or is there a sufficient variety of Juices in the Earth to feed all the different Species of Vegetables in the same Garden, or Country ? See below, §. 3.

⁵ Is there any Certainty in these Relations ? Is the Supposition of different Juices in the Earth confirmed ? Or do all Plants make their own Juices, respectively, from one or more common Juices of the Earth ? See below, *Sett.* VI. 1.

⁶ Are not the Seeds of these Flowers sown along with the Corn ?

Fruits, Herbs, and Roots, are bitter, harsh, sour, and watrish ; it were proper to make the following Trials. (1.) Set Wormwood, or Rue, near Lettuce, Colliflower or Artichoke ; to try whether these will become sweeter. (2.) Take a Service-Tree, a Cornelian, or Alder, whose Fruits have a harsh and astringent Juice ; and set them near a Vine, or Fig-tree ; to find whether the Grapes or Figs will thus be the sweeter. (3.) Set Cucumbers or Pompions among Musk-Melons ; to see whether the Melons will not be more vinous ; and better tasted. (4.) Set Cucumbers also among Radish ; to try whether the Radish will be the more biting. (5.) Set Sorrel among Rasberries ; to see whether the Rasberries will be the sweeter. (6.) Set common Briar among Violets, or Wall-flowers ; to see whether it will make the Violets or Wall-flowers sweeter, and of a less earthy Odour. (7.) So set Lettuce, or Cucumbers, among Rosemary, or Bays ; to try whether the Rosemary or Bays will become more aromatic. (8.) On the other hand, beware of setting such Plants together, as draw nearly the same Juice. I suspect Rosemary would lose part of its sweetness, if set with Lavender, Bays, or the like. (9.) Yet to correct the Strength of an Herb, others of like kind may be set near to lower it ; thus Tansey set by Angelica, may be made weaker, and fitter for Mixture in Perfumes : and Rue set by common Wormwood, might become liker to *Roman Wormwood* *.

6. Trial should also be made in poisonous and purgative Herbs, whose ill qualities might perhaps, be discharged, or corrected, by setting stronger Poisons, or Purgatives near them. 'Tis reported, that the Shrub call'd *Ladies-Seal*, (which is a kind of Briony) and Coleworts, if set near each other, one or both of them will dye ; being, I suppose, depredators of the Earth, so that one of them starves the other. The like is said of the Reed and the Brake ; both which are succulent : and therefore the one may defraud the other. Understand the like of Hemlock and Rue ; both which attract strong Juices †.

To correct poisonous and purgative Plants by Juxtaposition.

7. Many who have laboured in *Natural Magick*, observe a Sympathy between the Sun, Moon, some principal Stars, and certain Plants ; whence they have denominated some Herbs Solar, some Lunar ; and delivered such Trifles in lofty Language. 'Tis manifest, that some Flowers have two respects to the Sun ; the one by opening and shutting ; the other by bowing and inclining their Heads. For Marygolds, Tulips, Pimpernel, and most Flowers open their Leaves, when the Sun shines clear ; and in some measure close them, either towards Night, or when the Sky is overcast. Of this there needs no such solemn Reason, as that such Plants rejoice in the Presence, and mourn in the Absence of the Sun ; the Cause being no more

The Sympathy betwixt Plants and the celestial Bodies.

L 1 2

than

* These Experiments being here only recommended upon the preceding Supposition, that Plants, according to their several Natures, attract different Juices from the Earth, have not, perhaps, been made with sufficient Attention. The Advantages to be expected from the direct Experiments, are no sufficient Recommendation of them to Gardeners ; but they have a higher Use in assisting to determine whether there are different kinds of Juices in the Earth.

† Perhaps the certain Fact in these Matters is not hitherto fully discover'd ; for want of Sets of proper Trials, repeated with due Attention, and Accuracy.

than a little Moisture of the Air, which loads the Leaves, and swells them at the bottom; whereas the dry Air expands them. And some make it a wonder, that Garden-Clover should hide the Stalk when the Sun shines bright; tho' this be nothing but a full Expansion of the Leaves. The Plants that bow and incline the Head, are the great Sun-flower, Marygold, Wart-wort, Mallow-flowers, &c. The Cause of this is somewhat more obscure than the former; but I take it to be no other than that the part against which the Sun beats, grows weaker and more flaccid in the Stalk; and thence becomes less able to support the Flower^f.

*The Effect of
Moisture upon
Vegetables
shewn by an
Example.*

8. What Effect a little Moisture may have upon Vegetables, even tho' dead, and severed from the Earth, appears in the Experiment of Jugglers; who take the Beard of an Oat, which is wreath'd at the bottom, and a smooth entire Straw a-top; chusing only the wreathed part, and cutting off the other, so as to leave the Beard half an Inch long. Next they make a little Cross of a Quill, lengthwise of that part of the Quill which has the Pith, and cross-wise of that part which has none; the whole Cross being half an Inch high. Then they prick a Hole in the bottom where the Pith is, and put the Oaten-beard therein; leaving half of it sticking out of the Quill. Now they take a little white wooden Box, (as if somewhat in the Box did the feat) in which, with a Pin, they make a small Hole, to receive the Beard, without letting the Cross sink down. Lastly, they ask the Question; as which is the fairest Woman in the Company? or the like: and at every Question they stick the Cross in the Box; having first put it towards their Mouth, as if they charm'd it; and the Cross stirs not: but when they come to the Person they design; as they hold the Cross to their Mouth, they wet the Beard with the tip of their Tongue, and so stick the Cross in the Box; upon which it turns softly round three or four times, by the untwining of the Beard from the Moisture^g. This becomes more evident if you stick the Cross between your Fingers. Whence it appears, that the Motion produced by so little Moisture, is stronger than the closing or bending of the Head of a Marygold, &c.

*Whence the
Noon-day
Dew of the
Rosa Solis.*

9. 'Tis reported, that the Herb *Rosa Solis*, will at Noon-day, when the Sun shines hot and bright, have a great Dew upon it; and therefore that the right Name is *Ros Solis*. This they impute to a Sympathy it has with the Sun. Men favour Wonders. It were proper first to be sure, that the Dew found upon it, is not the Dew of the Morning preserved, when the Dew of other Herbs is breath'd away; for it has a smooth and thick Leaf, which does not discharge the Dew so soon as other Herbs, that are more
spongy

^f Whence proceeds that extraordinary Phenomenon of the sensitive or humble Plant, which falls flat upon being touched; and afterwards gently rises again?

^g This Property of the Oat-Beard to move with so little Moisture, has occasion'd it to be chose for making an Hygrometer, to shew the degree of Moisture in the Air, after the manner of the Hand of a Dial.

spongy and porous^b: and perhaps Purslane, or some other Herb, does the like. But if it has more Dew at Noon, than in the Morning; then it seems to be an Exudation of the Herb itself: As Plumbs sweat when put into the Oven.

10. 'Tis certain, that Honey-Dews are found more upon Oak-leaves than upon Ash, Beech, or the like: but whether the Leaf has any property of concocting the Dew; or whether the Thing happens only on account of the closeness, and smoothness of the Leaf, seems doubtful. It should be well examined, whether Manna falls only upon certain Herbs or Leavesⁱ. Flowers that have deep Sockets, gather in the Bottom a kind of Honey; as Honey-suckles, Lillies, and the like^k. And in these the Flower bears a part with the Dew.

*Honey Dewes,
why chiefly
found on Oak-
Leaves.*

11. The Froth call'd *Cucow-Spittle*, is found only upon certain hot Herbs; as Lavender, Sage, Hyssop, &c. Enquire into the Cause hereof; for it seems a Secret^l. Mildew also falls upon Corn, and smuts it; but the same falls also upon other Herbs, tho it is less observed.

*Cucow-Spittle
and Mildew.*

12. Let it be try'd, whether the great Consent betwixt Plants and Water, will cause an Attraction at a Distance, as well as in Contact. In the middle of a Vessel make a false Bottom of coarse Canvas; fill the Vessel with Earth above the Canvas, and let the Earth be kept dry; then sow some good Seed in this Earth; and under the Canvas, half a Foot in the bottom of the Vessel, place a large Sponge thoroughly wet in Water; and let it lye for ten Days; to try whether the Seeds will sprout, the Earth become moister, and the Sponge more dry^m.

*Whether
Plants will at-
tract Water at
a distance.*

S E C T.

^a An accurate Observation of the Structure of this Plant, might, perhaps, lead to a discovery of the whole Mystery. No Notice is here taken that the Leaves are somewhat hollow, covered all over and fringed at the Edges, with a kind of fine, short, red Hairs, which give the whole Leaf a red cast.

ⁱ See the *Article* MANNA.

^k And is not this sweet Substance a particular exalted Juice of the Plant, and the real Honey which Bees only collect from Flowers, and Treasure up in their Hives?

^l Is there not constantly found an Egg, Aurelia, small Worm, or Maggot, within this frothy Matter? By what Creature is this Egg laid; and into what does it turn? Of what Nature is the Froth from whence does it proceed; what is its Use; and how comes it not to exhale with the heat of the Sun? Lastly, is it found only upon aromatic Plants?

^m Has this Experiment been satisfactorily tried?

S E C T. VI.

Of rendring Fruits and Herbs Medicinal.

*The most likely
Methods of
producing al-
terations in
Plants.*

1. **A**Ttempts for altering the Scent, Colour, or Taste of Fruit, by infusing, mixing, or putting into the Bark, Root, Herb, or Flower, any aromatical, colour'd, or medicinal Substance, are but Fancies: *for these Things have pass'd their Period, and nourish not*^a. And every Alteration of Vegetables in those Qualities, must be effected by means of somewhat that is apt to enter the Nourishment of the Plant. It is certain, that where Cows feed upon wild Garlick, their Milk tastes plainly of it: and Mutton is better tasted when the Sheep feed upon wild Thyme, and other wholesome Herbs. *Galen* speaks of curing a schirrous Liver, by the Milk of a Cow that feeds upon certain Herbs; the Honey in *Spain* smells of the Rosemary, or Orange-Tree, from whence it was gather'd: and there is an old Tradition of a Courtezan fed with *Napellus*; which, tho' accounted the strongest vegetable Poison, yet, thro' Use, did not hurt her, but by Communication poison'd some of her Gallants. There is observed an efficacious Bezoar, and another without Virtue; tho' they appear alike: but the efficacious one is taken from the Beast that feeds where there are antidotal Herbs; and that without Virtue, from such as feed where no such Herbs grow. Again, steeped Wines, and Beers, are very medicinal; as likewise Bread mix'd with Powders: so Meat also, as Flesh, Fish, Milk, and Eggs, may perhaps be made of great Use for Medicine and Diet, if the Beast, Fowl or Fish, be fed with a particular kind of Food, proper for the Disease^c. This were dangerous Doctrine with regard to secret poisoning. But whether it may be applied to Plants, I question the rather because their Nourishment is a more common Juice; scarce capable of any particular quality before the Plant assimilates it^d.

*Four ways of
rendring
Plants medi-
cinal.*

2. But lest our incredulity should prevent any profitable Operations of this kind; especially since many of the Ancients have set them down; we will briefly touch upon the four Means they have devised for making Plants medicinal. The first is by sitting the Root, and infusing the Medicine therein; as Hellebore, Opium, Scammony, *Theriaca*, &c. then binding it up again. This seems the less promising, because the Root draws immediately from the Earth; and so the Nourishment is still common, and less qualified for the end propos'd. Besides, 'tis thus a long time before the

^a This is an Approximation to a very considerable Axiom.

^c Numerous capital Instances to this purpose might be collected from the *Philosophical Transactions*, *French Memoirs*, *German Ephemerides*, and Mr. Boyle's *Philosophical Writings*.

^d Hence it appears that the Author does not suppose the different Juices of Vegetables formally to exist in the Earth; but that they receive their several particular Properties and Virtues from the Action or Elaboration of the respective Plant. So that what is above delivered, as to Plants attracting different Juices from the Earth, is to be understood of crude, and not of concocted Juices, as they are found in the Vessels of Vegetables. See above, *Set. V. 2, 3.*

the Medicine reaches the Fruit. The *second* is, to perforate the Body of the Tree, and then to infuse the Medicine ; which is somewhat better : for if any Virtue be received from the Medicine, it has thus the shorter and quicker ascent. The *third* is, to steep the Seed or Kernel, in some Liquor wherein the Medicine is infused : which I have little Opinion of, because I suspect the Seed will scarce draw the Parts of the Matter, that have the Property : but it may be much more promising to mix the Medicine with Dung ; because the Seed naturally drawing the Moisture of the Dung, may receive some of the Property along with it. The *fourth* is, the frequent watering of the Plant with an Infusion of the Medicine. This in one respect may have more Force than the rest ; because the Means is frequently renewed ; whereas the rest are applied but once : whence the Virtue may the sooner vanish. But still I suspect the Root is somewhat too stubborn to receive such fine Impressions ; which have also a great way to ascend. I judge therefore the likeliest Method to be the perforation of the Body of the Tree, in several places one above another ; then the filling of the Holes with Dung, mix'd with the Medicine ; and watering these Parcels of Dung, by means of Squirts, with an Infusion of the Medicine in dunged Water, once in three or four Days ^a.

S E C T. VII.

Of Curiosities in Vegetation.

1. **T**IS a Curiosity to have several Fruits upon one Tree ; especially when some of them come early, and some late ; so that the same Tree shall bear ripe Fruit all the Summer. This is easily effected by grafting several Cions upon several Boughs of a Stock, in a good Ground, plentifully fed. Thus you may have all the kinds of Cherries, or of Plumbs, Peaches, or Apricots upon one Tree : but I conceive the diversity of Fruits must be such as will graft upon the same Stock ; and therefore question whether Apples, Pears, or Oranges, may be procured upon the same Stock whereon Plumbs are grafted ^{To produce different Fruits upon the same Tree.}.

2. 'Tis also a Curiosity to have Fruits of several Shapes and Figures. This is easily procured by fashioning them, when the Fruit is young, with Moulds of Earth or Wood. Thus you may have Cucumbers, &c. as long ^{To produce Fruits of different Shapes.} as

^a It were easy to derive a particular Experiment, for Trial, from the preceding Doctrine ; but it requires a Philosophical Disposition to make it. Few Gardeners would think it worth their while to keep constantly watering a Plant with a Solution of Opium, a Tincture of Cinamon, a Decoction of Coloquintida, &c. for Months together. But unless some such Experiments are tried with Care and Judgment, our Reason will never inform us what Effects are producible in this way.

^r It is commonly found that the several Fruits of the same Species, but not different Species, are producible by engrafting on the same Tree. Thus it has in vain been tried to produce Nuts, Cherries, Apples, Figs, &c. all upon one Stock. If this be constantly and invariably the Case ; what is the true physical Cause thereof ?

as a Cane, as round as a Ball, or formed like a Cross. You may also have Apples in the form of Pears or Lemmons. You may thus likewise have Fruit in the more curious Figures of Men, Beasts, Birds, &c. the Moulds being made large enough to contain the whole Fruit when grown to its full size; otherwise you will stop its spreading, so as not to fill the Concavity, and receive the Shape desired; as happens in Mould-works of fluid Bodies: Some doubt may arise, that thus keeping the Fruit from the Sun, may hurt it: but we find by common Experience, that Fruit will grow when cover'd. Perhaps also some small Holes may be advantageously made in the Mould, to let in the Sun. And it were best to make the Mould in two separable Parts, and glew or cement them together; that they may be open'd to take out the Fruit.

*Inscriptions on
Trees and
Fruit.*

3. 'Tis a Curiosity to have Inscriptions, or Engraving, appear on Fruit or Trees; which is easily procured by writing upon young Trees or Fruits with a Needle, Bodkin, or carving with a Knife: for, as they grow, so will the Letters grow more large and graphical.

*To adorn
Trees with
Flowers, &c.*

4. Trees may be adorned with Flowers or Herbs, by boring their Bodies, and putting into the Holes Earth mix'd with Manure; and setting Seeds, Slips of Violets, Strawberries, wild Thyme, Camomile, or the like, therein: for they will thus grow in the Trees, as in Pots; tho, perhaps, they receive some additional Nourishment from the Trees. The Experiment might also be tried with Shoots of Vines, and the Roots of red Roses; for these being of a more woody Nature, will, perhaps, incorporate with the Tree itself.

*To bring Trees
into certain
Shapes.*

5. It is a common Curiosity to bring Trees and Shrubs into various Shapes; by moulding them within, and cutting them without. But these are imperfect Things; being too small to keep their Figure. Large Castles made of Trees upon Timber Frames, with Turrets and Arches, were anciently matters of Magnificence.

*To improve the
Colours of
Flowers.*

6. Among Curiosities comes Coloration; for the preheminance in Flowers is Beauty. 'Tis observed, that July-flowers, Sweet-Williams, and Violets, that are coloured, if they be neglected, and neither water'd, new moulded, nor transplanted, will turn white: and, probably, the white, with much Culture, may turn colour'd. For the white Colour proceeds from scarcity of Nourishment; except in Flowers that are only white, and admit of no other Colour. 'Tis proper therefore to see what Natures accompany what Colours: whence Light may be had to induce Colours; by producing those

¹ These Experiments have been found to succeed, with regard to the Shapes of the Fruit; tho not so well perhaps with regard to its Goodness.

² This appears to have been an ancient Practice, and a kind of Amusement for Lovers.

Tenerisque meos incidere Amores

Arboribus; crescent illa, crescentis Amores.

It has also been used upon other occasions. There goes a Report of a certain Pear-Tree, that had the Name of *James*, or *Ormond* upon all its Fruit. The manner how this was procured, if different from that above, may deserve the Enquiry.

^u Observe for this purpose to bore the Holes somewhat sloping downwards, that the Mould and Moisture may lodge.

those Natures *. Whites are more inodorous than Flowers of the same Kind coloured ; as in single white Violets, white Roses, white July-flowers †, &c. Blossoms of Trees also, that are white, commonly prove inodorous, as Cherries, Pears, Plumbs ; whereas those of Apples, Crabs, Almonds and Peaches, are blusky, and smell sweet. The Cause is, that the Substance which makes the Flower is the thinnest Part of the Plant ; whence also Flowers are of such curious Colours : and if this be too sparing and thin, it attains no strength of Odour, except in such Plants as are very succulent ; which should therefore rather be stinted in their Nourishment, than replenished, to make them sweet : as we find in white Satyrion, which is of a curious Odour ; and in Bean-flowers, &c. Again, if the Plant put forth white Flowers only, and those not thin or dry, they are commonly of a rank and fullsome Odour ; as in Mayflowers, white Lillies, &c.

7. On the contrary, in Berries, the Whites are commonly more delicate, and sweet of Taste, than the coloured : as white Grapes, white Raspberries, white Strawberries, white Currans †, &c. The Cause is, that the coloured are more succulent, of coarser Juices, and not so well concocted ; whilst the white are better proportioned to the Digestion of the Plant. And Fruits.

8. But in Fruits, the White commonly are the coarsest ; as in Pear-Plumbs, Damascenes, &c. and the choicest Plumbs are black : the black Mulberry is better than the white. The Harvest White-plumb is coarse, and the Verdoccio and white Date-plumb, not very good, as being too watry ; whereas a higher Concoction is required for Sweetness : and therefore all fine Plumbs are a little dry, and easily part from the Stone ; as the Musk-plumb, the Damascene-plumb, the Peach, the Apricot, &c. Yet some Fruits which grow not to be black, are of the Nature of Berries ; sweetest when pale : as the Heart-cherry, which inclines more to white, is sweeter than the red ; but the Morelli, more sour †.

9. Sow Clove-July-flower-seed of one only Kind, and it will produce Flowers of different Colours ; as the Seed casually meets with Nourishment in the Earth : whence the Gardeners find two or three Roots among a hundred, that are rare, and of great price ; as Purple ; or Carnation of several Stripes : for there are very different Juices in the Earth, tho' contiguous, and in one Bed † ; and as the Seed meets with them, so it sprouts. And whence different coloured Flowers from the same Seed.

V O L. III.

M m

those

* See this Subject prosecuted by Mr. Boyle, in his *Experimental History of Colours*.

† Perhaps the reverse of this Observation is true, or the contradictory Instances numerous. Compare the white Lilly with the yellow, the white Musk-rose with the red ; white Jessamin, with the yellow ; the white Blossoms of the Pear, the Cherry, and the Plum-tree, with the variegated ones of the Peach, Nectarine, Apple, &c.

‡ The contradictory Instances should also be enumerated.

§ These Particulars, before they can be well adjusted, seem to require a further Enquiry into Colours, and the Origin and Causes of Forms, than is hitherto extant.

¶ Can these different Juices be extracted by a proper chemical Contrivance, and exhibited distinct to the Eye ? And supposing this Difference of Juices, how do they act in causing a Difference of Colour in the flowers ? or lastly, may not this Difference of Colour proceed from some Particular in the Seed ; tho' of the same general Kind with the rest ? No exact Solutions of such Queries are to be expected, without a rigid inductive Enquiry ; which few Philosophers seem disposed to enter upon.

those that come up Purple, always come single ; the Juice, as it should seem, not being able to allow a succulent Colour, and a double Leaf. This Experiment of several Colours produced from the same Seed, should be tried also, in Larks-foot, Monks-hood, Poppy, and Hollyoak.

Few Fruits
red.

10. Few Fruits are red within, except the Queen-apple, the Rose-apple, Mulberries, and red Grapes : tho this is chiefly towards the Skin. There is a Peach also, that has a Circle of red towards the Stone ; and the Morellicherry is somewhat red within ; but no Pear, Plumb, or Apricot, tho they have red Sides, are red within ^b.

The various
Colours of
Plants.

11. The general Colour of Plants is green, which no Flower is ; tho there be, indeed, a pale-greenish Primrose. The young Leaves of some Trees turn a little reddish ; as in Oaks, Vines, and Hazles. Leaves rot into a yellow ; and some Hollies have part of their Leaves yellow, that appear as fresh and shining as the green. Yellow also, seems to be a less succulent Colour than green ; and a degree nearer to white. For it has been noted, that these yellow Leaves of Holly always stand towards the North, and North-east. Some Roots are yellow, as Carrots ; and some Plants blood-red, Stalk and Leaf ; as the *Amaranthus*. Some Hrbns incline to purple and red ; as a Kind of Sage, a Kind of Mint, *Rosa Solis*, &c. And some have white Leaves ; as another Kind of Sage, and another Kind of Mint ; but Azure and a fair Purple, are never found in Leaves ^c : which shews, that Flowers are made of a refined Juice of the Earth, as well as Fruits ; but the Leaves of a more coarse and common one ^d.

To produce
double Flowers.

12. 'Tis a Curiosity to make Flowers double. This is effected by often removing them into new Earth ; as, on the contrary, double Flowers, by neglect, and want of removing, become single. The speedy Way is, to sow or set Seeds, or Slips of Flowers ; and, as soon as they come up, to remove them into good new Ground ^e. Enquire also, whether inoculating of Flowers, as Stocks, Roses, Musk-roses, &c. does not make them double ^f. There is a Cherry-tree that has double Blossoms ; but it bears no Fruit : and, perhaps, the same Means, which, applied to the Tree, greatly accelerate the Sap in rising, and breaking forth, will make the Tree spend itself in Flowers, and those double ; which would be beautiful, in Apple-trees, Peach-trees, and Almond-trees, that have blush-coloured Blossoms.

Ways for pro-
ducing Fruits
without Stone
or Core.

13. The producing of Fruits without Core or Stone, is likewise a Curiosity, and somewhat more ; because whatever has this Effect, may render them

^b Enquire into the Colour of the Blood-red tinging Grape, the prickly Pear, &c.

^c By way of contradictory Instances, remember the Veitch, the Garden or Field-violet, the Passion-flower, the *Viola Tricolor*, &c.

^d See the Article PERCOLATION.

^e This is found to answer upon Trial ; especially when some of the Flowers are plucked off, that the rest may thrive the better.

^f The Gardeners declare it does not ; the Bud inoculated constantly retaining its own Nature, as in the case of Grafting.

them more tender and delicate. But the Methods hitherto proposed for this Purpose, are generally trifling and insufficient^ε.

S E C T. VIII.

Of the Generation of Plants, and their Transmutation into one another.

1. **T**IS certain that Plants, for want of Culture, degenerate; and, sometimes, so far as to change into another kind^δ. Long standing, without removal, makes them degenerate. Drought, unless the Earth be moist, has the like Effect: so has removing them into worse Earth, or forbearing to manure the Ground. Thus Water-mint turns to Field-mint, Colewort into Rape, &c. Whatever Fruit thrives upon a Root, or a Slip, will degenerate, if it be sown. Grapes, Figs, Almonds, and Pomgranate-kernels sown, make the Fruits degenerate and become wild. Again, most of those Fruits that use to be grafted degenerate, if Set of Kernels, or Stone. Peaches indeed succeed better from the Stone, than upon Grafting^ι: and the Rule of Exception seems to be this, that whatever Plant requires much Moisture, prospers better upon the Stone or Kernel, than upon the Graft. For the Stock, tho it gives a finer Nourishment, yet gives less than the Earth at large. Seeds, if very old, and yet of strength to produce a Plant, make the Plant degenerate; therefore skilful Gardeners try their Seeds before they buy them, by putting them into Water as it is gently boiling; for, if good, they will new sprout within half an Hour^κ.

The Causes of Degeneration in Plants.

2. There goes an Opinion, that if the same Ground be often sown with the same Grain, the Grain, in the end, becomes of a baser Kind. In very barren

The same Seed degenerates by often sowing in the same Ground.

M m 2

^ε These Methods turn upon preventing the growth or increase of the Pith of the Tree; from whence the Stone and Core of the Fruit have been supposed to proceed; constantly watering with warm Water; Grafting a sour Fruit upon a sweeter Stock; and all the known Means of converting wild Trees into Garden ones. But nothing of this kind is said to be effectual. And indeed, this Business of Exosculation appears difficult; and, if performed, might be a capital Instance of the human Power over Nature. An Instance of Approximation we have in the Castration of Animals; which makes them thrive better, and grow fatter. Were it not for such Instances, the Undertaking might seem desperate; as tending to deprive the Fruit of its Seed; and weakening, crossing, and destroying, instead of strengthening, invigorating, and co-operating with Nature. But what Instances of Encouragement are there in Vegetables themselves? Barberries have been sometimes found without Stones; but then they usually appear in a shrunk or withered State. The Instances of this kind should be collected, and the proper manner and time of Castration thought of in Imitation of the Operation in living Creatures; till a more commanding Knowledge be gained of the Nature and Forms of Vegetables.

^δ It deserves to be carefully observed, whether Plants by degenerating actually change their Species.

^ι But, if Inoculating be used instead of Grafting, the case is otherwise.

^κ The heaviest Seeds, or such as sink the fastest in Water, are usually esteemed the best for sowing.

barren Years, the Corn that is sown, becomes of a different kind ¹. And 'tis a Rule, that Plants produced by Culture, as Corn, will sooner change into another Species, than those that come of themselves; for Culture gives but an adventitious Nature, which is more easily put off ^m.

The Transmutation of Plants possible.

3. The Transmutation of Plants one into another, is a capital Work of Nature; the Transmutation of Species being pronounced impossible. 'Tis a thing of difficulty, and requires deep Search into Nature; but, as there appear some manifest Instances of it ⁿ, the Opinion of Impossibility is here to be rejected, and the Means to be sought.

Rules for effecting it.

Rule 1.

4. In order to change one Plant into another, the Nourishment must overrule the Seed; and therefore the thing should be attempted by Nourishments as contrary as possible to the Nature of the Plant; yet so as it may grow: and with Seeds of the weakest sort, or that have the least Vigour. It were therefore proper to plant sedgy Herbs in hilly or champain Ground; and such Herbs as require much Moisture, upon sandy and very dry Ground: for Example; Marsh-mallows and Reeds, upon Hills; Cucumbers, Lettuce, and Colewort, upon Sand. On the other hand, plant Bushes, Heath, Ling, and Brakes, in wet or marshy Ground. I conceive likewise, that all esculent and garden Herbs, set upon the tops of Hills, prove more medicinal, tho less esculent than before ^o. Perhaps also, some wild Herbs will make Sallad-herbs. This is the first Rule for the Transmutation of Plants.

Rule 2:

5. The second Rule may be, to set some few Seeds of the Herb to be changed, among other Seeds; to try whether the Juice of these other Seeds will not so qualify the Earth, as to alter the Seed to be operated upon: for example; sow Parsley-feed among Onion-feed, or Lettuce-feed among Parsley-feed; and try if, by this means, there will be any change of Taste, or otherwise. But it were proper to separate the Seed designed to be changed, from the foreign Seed, by the Interposition of a piece of Linen.

Rule 3.

6. The third Rule may be, the making some Mixture of Earth with other Plants bruised, either in Leaf or Root: for example, make up Earth with a Mixture of Colewort-Leaves stamped, and set Artichoaks, or Parsnips in it; or take Earth mixed with Marjoram, Origanum, or Wild-thyme bruised, and set in it Fennel-feed, &c. It is not here designed, that the Herb to be wrought upon, should draw the Juice of the foreign Herb; but, I conceive, there will be a new Preparation of Mould, which, perhaps, may alter the Seed from the Kind of the former Herb.

7. The

¹ *Grandia saepe quibus mandavimus hordia Sulcis, Infelix Lolium, & steriles dominantur Avena.*

^m These Particulars require to be diligently examined into. See Dr. Sharrock's History of the Propagation and Improvement of Vegetables, by the concurrence of Art and Nature, pag. 28, &c.

ⁿ Let these Instances be enumerated, and carefully examined; as to their Certainty and Justness.

^o How is this found upon the Hills about Montpellier in France?

7. The *fourth Rule* may be, to mark what Herbs some Earths produce spontaneously ; and to pot or vessel up that Earth, and in it set the Seed you would change. Thus take Earth from under Walls, or the like, where Nettles grow in abundance, without any String or Root of the Nettles ; pot that Earth, and set in it Stock-July-flowers, or Wall flowers ; or sow the Seeds of them therein ; and try the Event. Or take Earth prepared to put forth Mushrooms of itself ; and sow therein Purslane, or Lettuce-seed : for in these Experiments, 'tis probable, that the Earth being accustomed to afford one kind of Nourishment, will alter the new Seed.

Rule 4.

8. Let the *fifth Rule* be, to make the Herb grow contrary to its Nature ; as to make ground Herbs rise in height. Thus carry Camomile, Wild-thyme, or the green Strawberry, upon Sticks, as they do Hops upon Poles ; and observe the issue.

Rule 5.

9. Let a *sixth Rule* be, to make Plants grow out of the Sun's reach ; for this is a great Change in Nature, and may induce a Change in the Seed. Thus, barrel up Earth, sow some Seed in it, and place it at the bottom of a Pond, or a great hollow Tree. Try also, the sowing of Seeds in the bottoms of Caves ; and Pots with Seeds sown, hung in Wells, some distance from the Water, and observe the Event ².

Rule 6.

SECT. IX.

Of the Tallness, Lowness, and artificial Dwarfing of Trees.

1. **T**Imber-Trees, in Coppice Woods, grow more upright, and freer from under Boughs, than those in the Field : Vegetables having a natural Motion of rising to the Sun. Besides, they are not glutted with too much Nourishment ; because the Coppice shares with them : and *Repletion always hinders Stature* ¹. Lastly, they are kept warm ; which, in Plants, constantly promotes their mounting.

Whence the Tallness of Trees in Coppices.

2. Trees that are full of Heat, which appears by their inflammable Gums, as Firs and Pines, mount in height, without shooting out side Boughs, till towards the Top. The *Cause* is, partly Heat, and partly tenuity of Juice ; both which drive the Sap upwards. As for Juniper, 'tis but a Shrub ; and grows not large enough in the Body to maintain a tall Tree.

Why bet Trees have tall Trunks.

3. 'Tis *reported*, that a strong Canvas spread over a low-grafted Tree, soon after it shoots, will dwarf it, and make it spread. The *Cause* is manifest ; for all things that grow, must grow as they find room ².

The dwarfing of Trees by Covering.

4. Trees

¹ Observe that these are not proposed as perfect *Rules* ; which put in practice shall certainly produce the Effect ; but only as Attempts, by means of certain well adapted *Experiments*, to discover such *Rules*.

² Is this *Axiom* sufficiently verified ? If it be, it affords a Rule for producing considerable Effects.

³ This Experiment is found to answer ; so that Fruit-trees may be thus dwarfed to advantage ; and also have their Fruit preserved both from the scorching Sun, and the Birds.

By planting
Slips.

4. Trees are generally set from Roots, or Kernels; but if from Slips, as particularly the Mulberry, some of the Slips will grow; and, 'tis said, become Dwarf-Trees: because a Slip draws Nourishment weaker than a Root or Kernel^r.

The Requisites
to Dwarfing.

5. All Plants that put forth their Sap hastily, have their Bodies not proportionable to their length, and are therefore Winders and Creepers; as Ivy, Bryony, Hops, Woodbine, &c. whereas Dwarfing requires the Sap to rise slow, and a less Vigour in mounting.

SECT. X.

Of the Rudiments and Excrefcencies of Plants.

The Nature
and Growth of
Mofs.

1. **S**olomon wrote a *Natural History* from the Cedar of Libanus to the Mofs growing upon the Wall. And indeed Mofs is but the Rudiment of a Plant, growing chiefly upon Ridges of Houses, whether tiled or thatched; and upon the Crests of Walls: and this Mofs is of a lightsome and pleasant Green. It grows upon Slopes; because, as it proceeds from Moisture and Water, so the Water must slide, and not stand or stagnate. And its growing upon Tiles, or Walls, &c. proceeds from hence; that those dried Earths, having not Moisture sufficient to put forth Plants, practise Germination by putting forth Mofs: tho, when by Age, or otherwise, they relent and resolve, they sometimes put forth Plants; such as Wallflowers. And almost all Mofs has here and there little Stalks, besides the low Thrum.

Where it chief-
ly rises.

2. Mofs grows upon Walks, especially such as are cold, and exposed to the North; as in divers Terrasses, if they be trodden, or if they were, at first, gravelled; for wherever Plants are kept down, the Earth puts forth Mofs.

Grows on old
Ground, and
old Trees.

3. Old Ground that has long lain fallow, gathers Mofs: whence Husbandmen cure their Pasture-grounds when they grow to Mofs, by Tilling them for a Year or two; which also depends upon the same Cause: as the more sparing and starving Juice of the Earth, which is insufficient for Plants, breeds Mofs. And old Trees are more mossy than young ones; the Sap being not so vigorous as all to rise to the Boughs; but grows languid by the way, and puts out Mofs.

And near
Fountains.

4. Fountains have Mofs growing about them: for Fountains drain the Water from the adjacent Ground, and leave but sufficient Moisture to breed Mofs; whereto the coldness of the Water also conduces.

The Mofs of
Trees, what.

5. The Mofs of Trees is a kind of Hair, or the Juice of the Tree secreted, that does not assimilate: and upon great Trees, the Mofs grows in a Figure, like a Leaf.

6. The

^r Do not those Trees that will grow from Slips, naturally become Dwarfs, if all their Side-shoots are suffered to grow without cutting?

6. The moister sort of Trees yield little Moss; as Asps, Poplars, Willows, Beeches, &c. partly because of the quick rising of the Sap into the Boughs; and partly because the Barks of these Trees are more close and smooth than those of Oaks and Ashes; whence the Moss can hardly issue out.

*Why moist
Trees yield
little Moss.*

7. All Fruit-Trees grow full of Moss in Clay Grounds, both upon the Body and Boughs; partly from the coldness of the Ground, whence the Plants are nourished less; and partly from the toughness of the Earth, whereby the Sap is confined, and cannot get up to spread freely.

*Why Trees
grow mossy in
Clay Grounds,*

8. We have already observed, that if Trees be Bark-bound, they grow less fruitful, and gather Moss; and that they are cured by hacking, &c. On the contrary, if Trees be bound in with Cords, they will put forth more Moss: which also happens to Trees that stand bleak. It should also be tried, whether a Tree covered somewhat thick upon the top, after polling, will not gather more Moss. I judge also, that to water Trees with cold Spring-water, makes them grow mossy.

*Experiments
for making
Trees mossy.*

9. The Perfumers have a Moss yielded by the Apple-tree, and of an excellent Odour*. The manner of its Growth and Nature should be enquired after. For the sake of this Moss, it being a thing of Price, I have, above, set down the Ways of multiplying Mosses†.

*Apple-tree
Moss, a Per-
fume.*

10. Next to Moss come *Mushrooms*; which are likewise an imperfect Plant. Mushrooms have two strange Properties; the one, that they yield a delicious Meat; the other, that they come up in a Night; and yet are unfown. They must necessarily, therefore, be made of much Moisture; and that Moisture fat and gross, yet somewhat concocted. And indeed we find, that Mushrooms cause what they call the *Incubus*, or *Night-mare*, in the Stomach: whence a Surfeit of them may suffocate and poison‡. This shews they are windy, and that Windiness gross and swelling; not sharp or gripping. And, for the same reason, *Mushrooms* are provocative.

*Mushrooms
have two ex-
traordinary
Properties.*

11. 'Tis reported, that the Bark of white or red Poplar, cut small, cast into Furrows, and well dunged, will cause the Ground to put forth Mushrooms, at all Seasons of the Year, fit for eating. Some add to the Mixture, Baker's Leaven dissolved in Water. And, it is said, that if a hilly Field where the Stubble is standing, be set on fire in a showry Season, it will afford great store of Mushrooms. 'Tis also said, that Hartshorn-shavings mixed with Dung, and watered, yield Mushrooms; and Hartshorn is of a fat and clammy Substance: perhaps, Ox-horn would do the like‡.

*The ways of
producing
Mushrooms.*

12. There

* See above, *Seff.* III. 6, 15.

† This Moss seems to be a casual Thing upon Apple trees, that is not often to be found; and perhaps depends on a certain small degree of Putrefaction in the Moss.

‡ There is a curious Account of the *Mosses* in Scotland, to be found in the *Philosophical Transactions*, Numb. 330.

§ There are several Species of Mushrooms; but have the red-gill'd Species ever been found poisonous, pernicious, or surfeiting?

¶ Great Light is given to this whole Affair of *Mushrooms*, by the *Memoirs of the Royal Academy of Sciences at Paris*. See in particular, for the Year 1707. *Hist.* pag. 46. and *Memoir.* p. 58.

12. There is no known Substance but Earth, and the Produces thereof, as Tiles, Stones, &c. that yields any Moss, or herby Substance. Trial may be made, by putting Seeds into little Holes bored in the Horns of Stags, or Oxen, to see if they will grow ^a.

*The Growth
of Toad-stools.*

13. There is another imperfect Plant, to appearance like a great Mushroom; sometimes as broad as a Hat, and called a Toad's-stool: but 'tis not esculent; and commonly grows adjacent to the dead Stump of a Tree, or the Roots of rotten Trees: and therefore seems to take its Juice from putrefied Wood. Which shews, by the way, that putrefied Wood yields a free Moisture ^b.

*A Cake-like
Excrescence
on Trees.*

14. There is a nameless Cake that grows upon the Side of a dead Tree, large, of a Chestnut colour, hard and pithy ^c; whence it should seem, that even dead Trees continue to put forth, as the dead Bodies of Men do Hair and Nails for a time.

The Fuz-ball.

15. There is a Bug, or Fuzzy-ball, growing common in the Fields, that at the first is hard, like a Tennis-ball, and white; but after grows of a Mushroom-colour, and full of light Dust upon the breaking: 'tis thought to be dangerous to the Eyes, if the Powder gets into them; and good for Kibes: being probably of a corrosive and fretting Nature ^d.

Jew's-ear.

16. There is an Excrescence, called *Jew's-ear*, that grows upon the Roots, and lower parts of Trees, especially of Elder, and sometimes upon Ash. It has a strange Property; for, in warm Water, it swells and opens extremely. 'Tis of a dusky-brown colour, and used in the *Quinsy* and *Inflammations of the Throat*; whence it seems to have a mollifying Virtue ^e.

Agarick.

17. There is also a kind of spongy Excrescence, growing chiefly upon the Roots of the Laser-tree, and sometimes upon Cedars, &c. 'Tis very white, light and friable; we call it *Agarick*, and 'tis famous in Physick, for purging viscid Phlegm. 'Tis also an excellent Opener of the Liver; but offensive to the Stomach, and the Taste: being first sweet, and afterwards bitter.

*The History of
Misseltoe.*

18. We find no *Super-plant* that is fairly formed and figured, except *Misseltoe*: as to which we have an idle Tradition of a Bird, called a *Missel-bird*, that feeds upon a Seed she cannot digest, and so expels it whole with her Excrement; which falling upon the Bough of a Tree, produces the *Misseltoe*. But this is a Fable; it being not probable that Birds should feed upon what they cannot digest. Besides, *Misseltoe* is found but upon certain Trees, that bear no Fruit to allure that Bird, which feeding upon the *Misseltoe-berries*,

^a What are the *Instances of Approach* in this case? Consider of the Vegetation upon the white Cake of Salt left after the Distillation of *Glauber's Spirit of Nitre*. Consider also, the Growth of Mushrooms upon Chirurgeons Dressings, &c. See the *French Memoirs* in the Places above quoted.

^b See *Philosoph. Transact.* Numb. 330.

^c Is not this Leather-like Excrescence, somewhat analogous to the *Nostock*, or *Star-shoot*?

^d This is the *Crepitus Lupi*, or common Fuz-ball; and said to be a powerful Styptic.

^e It has also a particular faintish Odour, when boiled; and then somewhat resembles a piece of black, well-dressed, supple Leather.

berries, and therefore being often found there, may have given occasion to the Tale. But what ends the Dispute is, that *Mistletoe* has been found under the Boughs, and not only above them; so that it cannot proceed from any thing that falls upon the Boughs. It chiefly grows upon Crab-trees, Apple-trees, sometimes upon Hazels, and rarely upon Oaks^f; the *Mistletoe* whereof is accounted very medicinal^g. 'Tis an Evergreen, that bears a white glittering Berry, and differs entirely from the Tree whereon it grows. Two things therefore, may be hence collected: *First*, that Superfoetation proceeds from plenty of Sap in the Bough. *Secondly*, that the Sap must be such as the Tree discharges, and cannot assimilate; else it would go into a Bough: and besides, it seems more fat and unctuous than the ordinary Sap of the Tree; both by the Berry, which is clammy, and because it continues green, Winter and Summer, which the Tree does not^h.

19. This Observation upon *Mistletoe*, may give some light to other Practices. Trial therefore should be made, by ripping the Bough of a Crab-tree in the Bark, and watering the Incision every day with warm Dung-water; to see if it will produce *Mistletoe*, or any thing like it: but it were yet more promising, to try it with other Watering and Anointing, less natural to the Tree; as Oil, Beer, Yeast, &c. provided they be such as do not kill the Bough.

Experiments derived from it.

20. It were proper to try how Plants would grow, if prevented from Shooting their natural Boughs. Poll a Tree therefore, and cover it thick with Clay on the Top; and mark the Event. I suppose it will put forth in Roots; for so a Cion will, being turned down into Clay. Therefore, in this Experiment also, the Tree should be closed with somewhat not so natural to it as Clay. Try Leather, Cloth, or Painting; provided it be not hurtful to the Tree. 'Tis certain that a Brake has grown out of a Pollardⁱ.

How Plants will grow that do not shoot in Boughs.

21. The Prickles of Trees seem to be a kind of Excrecence; for they will never become Boughs, nor bear Leaves. The Vegetables that have Prickles, are the black and white Thorn, the Briar, the Rose, the Crab-tree, the Gooseberry, the Barberry; these have it in the Bough. The Plants that have Prickles in the Leaf, are Holly, Juniper, Whin, Thistle; Nettles also have a small venomous Prickle; as Borage has a harmless one. The Cause seems to be hasty Shooting, want of Moisture, and closeness of Bark: for the haste of the Spirit to put forth a Bough; the want of Nourishment for the Purpose: and the closeness of the Bark, produces Prickles in Boughs: whence they are always pyramidal; the Moisture spending itself after a little Shooting. Prickles in Leaves, come also from putting more Juice into the Leaf than can spread smooth therein; and therefore

The Prickles of Trees, what.

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the

^f Its Growth upon the Oak has been questioned. I once saw it in considerable plenty, growing upon a very young Oak; which, for the Curiosity, was sold at an extraordinary Price, to an Apothecary of London.

^g What Certainty is there in the Relation of its being specific in the Epilepsy?

^h For a farther Account of *Mistletoe*, see the *Philosophical Transactions*, Numb. 251, &c.

ⁱ The manner wherein, should be examined.

the Leaves are otherwise rough ; as in Borage and Nettles. The Leaves of Holly are smooth, yet never plain ; but, as it were, folded, for the same Reason.

*The Cause of
Down on
Plants.*

22. There are also Plants, which, tho they have no Prickles, yet have a kind of downy or velvet Covering upon their Leaves ; as Rose-campion, Stocks, Colts-foot, &c. which Down or Nap proceeds from a subtil Spirit, in a soft or fat Substance ; for both Stock-July-flowers, and Rose-campion, stamped, have been successfully applied to the Wrists, in *Tertian* or *Quartan Agues* : and the Vapour of Colts-foot is healing to the Lungs ; as the Leaf also, is healing in Chirurgery.

*Other Excre-
scences in Trees.*

23. Another kind of Excrecence is an Exudation of Plants, joined with Putrefaction ; as in Oak-apples, which are found chiefly upon the Leaves of Oaks, and Willows. The Country-people have a kind of Prediction, that if the Oak-apple, when broken, be full of Worms, 'tis a Sign of a pestilential Year ; which seems probable, because they proceed from Corruption. There is also, upon Brier, a fine Tuft, or Bush of Moss, differently coloured ; which if cut, is always found full of little white Worms *

S E C T. XI.

Of the Production of perfect Plants, without Seeds.

*That Earth
will produce
Plants with-
out sowing.*

1. **E**arth taken from the Bottom of Vaults, Houses, and Wells, and put into Pots, will afford various Kinds of Herbs ; but some time is required for the Germination: If taken from a Fathom deep, it will put forth the first Year ; if much deeper, not till a Year or two after. The Nature of Plants growing in the Earth so taken up, follows the Nature of the Mould : if the Mould be soft and fine, it produces soft Herbs ; as Grass, Plantain, &c. and if harder and coarser, Herbs more rough ; as Thistles, Furz, &c. It is common Experience, that in Alleys close gravelled, the Earth brings forth, the first Year, Knot-grass ; and afterward Spire-grass : for the hard Gravel or Pebble, at the first laying, will not suffer the Grass to come out upright ; but turns it, to find its way where it can : but when the Earth is somewhat loosened at the Top, the ordinary Grass comes up. And it is reported, that Earth taken, at some depth, out of shady and damp Woods, and potted, will produce Herbs of a fat and juicy Substance ; as Penny-wort, Purslane, Houseleek, Penny-royal, &c.

*That Water
produces
Plants.*

2. Water also yields Plants that have no Roots fixed to the Bottom : but these are less perfect Plants ; being chiefly Leaves, and small ones, such as Duck-weed ; which has a Leaf no bigger than Thyme, but of a fresher green, and shoots a little String into the Water, far from the Bottom. The Water-lilly has its Root in the Ground ; so have many other Herbs that grow in Ponds.

3. 'Tis

* Pursuant to the Design, all the other Excrecences of Vegetables should be here enumerated ; even those discovered by the Microscope. See Dr. Hook's *Micographia*.

3. 'Tis reported likewise, that some Plants grow upon the Top of the Sea ; being supposed to proceed from a certain Concretion of Slime in the Water, when the Sun beats hot, and the Sea stirs little. As for Sea-weed and Sea-thistle, they both have Roots ; but the Sea-weed under the Water ; and the Sea-thistle upon the Shore. *Plants growing on the Sea.*

4. The Ancients have noted, that some Herbs grow out of Snow, laid up close together and putrefied ; and that they are all bitter : they name one, in particular, *Flomus*, which we call Moth-mullein. And Worms are frequently found in Snow, like Earth-worms ; whence, possibly, it may likewise yield Plants. *In Snow.*

5. The Ancients also affirm, that some Herbs grow out of Stone : which may be ; for Toads have been found in the middle of Free-stone. We also see, that Flints lying above ground, gather Moss ; and some Flowers grow upon Walls ; but whether upon the main Brick, or Stone, or whether out of the Lime or Chinks, is not well observed : for Elders and Ashes have been seen growing out of Steeples, tho manifestly from the Clefts ; insomuch that when they grow large, they will disjoin the Stones. There are likewise Rock-herbs ; but, I suppose, only where there is some Mould or Earth. It has likewise been found, that great Trees, growing upon Quarries, have shot down their Root into the Stone. *In Stone.*

6. 'Tis reported, that in some Mines of *Germany*, there grow Vegetables at the Bottom ; and, the Workmen say, they have a magical Virtue, and will not suffer them to be gathered. *At the Bottom of Mines.*

7. The Sea-sand seldom bears Plants ; because the Sun exhales the Moisture before it can incorporate with the Earth, and yield a Nourishment for Plants. 'Tis also affirmed, that Sand has its Root in Clay ; and that there are no Veins of Sand any great depth within the Earth. *And but seldom in Sands.*

SECTION. XII.

Of Exotick Plants.

1. 'TIS reported, that Earth brought from the *Indies*, and other remote Countries, by way of Ballast, being thrown upon some Ground in *Italy*, produced foreign Herbs, unknown to us in *Europe* ; and that from their Roots, Barks and Seeds bruised together, mixed with Earth, and well watered with warm Water, there came forth Herbs much like the other. *Foreign Earth producing foreign Plants in Europe.*

N n 2

2. Plants

¹ None of the Instances here produced, make expressly for the Title ; viz. *The Production of perfect Plants without Seed* ; but only for their Production without the Seed being sown by Men. But there are many ways of sowing Seed, by the means of Birds, Beasts, Winds, the spontaneous bursting of Flowers, &c. all which deserve to be enumerated. And perhaps it will at length be found, that every Species of Vegetables, even Mushrooms, have their Seed, and are propagated by means thereof. See the Account of *Mushrooms* in the *French Memoirs*.

How to pre-
serve the Exo-
ticks of hot
Countries.

2. Plants brought out of hot Countries, endeavour to put forth at the same time they usually do in their own Climate: therefore, to preserve them, there is no more required, than to keep them from being put back by Cold. 'Tis also reported, that Grain transplanted from a hot Country to a colder, will be more forward than the ordinary Grain of the cold Country. This may succeed better in Grain than in Trees; because Grain is but annual, and so the Virtue of the Seed is not worn out; whereas a Tree is debafed by the Ground whereto it is removed.

Orange and
Lemon Seed
yielding Sal-
lading.

3. Many Plants which grow in the hotter Countries, will, if sown of Seed, late in the Spring, come up and endure most part of the Summer; as we find in Oranges, Lemmons, &c. the Seed whereof, sown at the end of April, yields excellent Sallads, mixed with other Herbs. And, I conceive, that the Seeds of Clove, Pepper, &c. if they could be had green enough to be sown, would do the like^m.

SECT. XIII.

Of the Seasons of Plants.

The earliest
Flowers.

1. **S**OME Flowers, Blossoms, Grains, and Fruits, come early, and others late in the Year. The early Flowers, with us, are Primroses, Violets, Anemonies, Water-daffadils, the *Crocus Vernus*, and some Tulips. These are all cold Plants; which therefore seem to have a quicker Perception of the heat of the Sun than hot Herbs have: as a cold Hand sooner perceives a little warmth than a hot one. Those that come next in order, are Wall-flowers, Cowslips, Hyacinths, Rosemary-flowers, &c. then Pinks, Roses, the Flower-deluce, &c. The latest are July-flowers, Holly-oaks, Larks-foot, &c.

The next in
order.

The latest.

The earliest
Blossoms.

2. The earliest Blossoms are those of the Peach, Almond, Cornelian, Mezereon, &c. being of such Trees as have much Moisture, either watery or oily. Whence the *Crocus Vernus* also, an Herb that has an oily Juice, puts forth early; for these likewise find the Sun sooner than the drier Trees.

The order
wherein Grain
ripens.

3. Of the Grains, the first are Rye, and Wheat; the next Oats, and Barly; then Peas and Beans: for tho green Peas and Beans are eaten sooner; yet the dry ones used for Horses, are ripe last: and it seems, that the fatter Grain comes first.

The order
wherein Fruit
ripens.

4. The earliest Fruits are Strawberries, Cherries, Gooseberries, Currans, certain Apples, Pears, Apricots, Raspberries; and after these, Damascenes, most kinds of Plumbs, Peaches, &c. the latest are Winter-apples, Wardens, Grapes, Nuts, Quinces, Almonds, Sloes, Briar-berries, Hips, Medlars, Services, Cornelians, &c.

5. Com-

^m This Article of Exoticks remains very deficient. In order to supply it, consult the Botanical Papers of the *Philosophical Transactions*; *French Memoirs*; and *German Ephemerides*.

5. Commonly Trees that ripen latest, blossom soonest; as Peaches, Sloes, Almonds, &c. and it seems a Work of Providence, that they blossom so soon; as they could not, otherwise, have the Sun long enough to ripen ^a. *Trees that ripen latest, blossom soonest.*

6. Some Fruits come twice a-year; as certain Pears ^o, Strawberries, &c. and they seem such as abound with Nourishment; whence, after one Period, before the Sun grows too weak, they can endure another. The Violet also, among Flowers, comes twice a-year, especially the double-white: and this also is a Plant full of Moisture. Roses also come twice; but not without cutting. *Some Fruits and Flowers come twice a-year.*

7. In *Muscovy*, tho the Corn come not up till late Spring, yet their Harvest is as early as ours; because the strength of the Ground is kept in by the Snow: and with us, if it be a long Winter, 'tis commonly a plentiful Year. After such Winters likewise, the Flowers and Corn, both earlier and later, come commonly at the same time; which often proves troublesome to the Husbandman. Sometimes Red-roses and Damask-roses come together. So likewise the Harvest of Wheat and Barly. But this always happens, because the earlier stays for the later; and not, that the later comes sooner. *Whence an early Summer in Russia.*

8. Many Fruit-trees, in hot Countries, bear Blossoms, young Fruit, and ripe Fruit, almost all the Year successively ^p. And 'tis said, the Orange and the Fig do the like with us, for a great part of Summer. And no doubt this is the natural Motion of Plants; but either wanting Juice to spend, or meeting with the Cold of the Winter; this Circle of Ripening cannot take place, but in succulent Plants and hot Countries ^q. *Whence Fruits and Blossoms come together.*

9. Some Herbs are annual, and die, Root and all, once a-year; as Borage, Lettuce, Cucumbers, Musk-melons, Basil, Tobacco, Mustard, and all kinds of Corn. Some continue many Years; as Hyssop, Germander, Lavender, Fennel, &c. There are two *Causes* of this dying: the first is, the tenderness and weakness of the Seed, which makes the Period in a small time; as in Borage, Lettuce, Cucumbers, Corn, &c. and therefore none of these are hot. The other is, because some Herbs can less endure Cold; as Basil, Tobacco, Mustard-seed: all which have much Heat. *Whence some Plants are annual, and others not.*

S E C T.

^a Let the *Contradictory Instances* be sought.

^o The Windsor-Pear, for Instance.

^p Particularly in *Bermudas*.

^q How near can Art approach this natural Advantage of Climate? Let a proper *Thermometer* be contrived to regulate the Heat of a Green-house: and let the natural Reciprocation of Warmth, Coolness, Moisture, and fresh Air, be imitated to Exactness.

S E C T. XIV.

Of the Duration of Herbs and Trees.

What Vegetables are most durable.

1. **V**Egetables of the largest Body are most durable; as Oak, Elm, Chestnut, &c. This holds in Trees; but in Herbs 'tis often otherwise: for Borage, Colewort, and Pompions, which are Herbs of the largest Size, are of small Duration; whereas Hyssop, Winter-savoury, Germander, Thyme, and Sage, will last long. The Reason is, because Trees last according to the Strength and Quantity of their Sap; being well defended by their Bark, against the Injuries of the Air: but Herbs draw a weak Juice, and have a soft Stalk; and therefore those among them that last longest, have a strong Smell, and a woody Stalk.

Mast-Trees lasting.

2. Trees that bear Mast, and Nuts, are commonly more lasting than such as bear Fruits; especially the moister Fruits: thus the Oak, Beech, Chestnut, Walnut, Almond, Pine, &c. last longer than the Apple-tree, the Pear-tree, &c. because of the fatness and oiliness of the Sap; which always wastes less than the more watery.

Late Trees the more durable.

3. Trees that put forth their Leaves late, and also shed them late in the Year, are more durable than such as sprout early, or shed betimes: for the coming late shews a Moisture more fixed; the other more loose, and easier resolved. For the same Reason, wild Trees last longer than than garden Trees; and of the same Kind, such as have acid Fruit, longer such as have a sweet one.

Frequent cutting preserves Trees.

4. Nothing makes Trees, Bushes, and Herbs more durable than frequent cutting. This always causes a renovation of the Sap, which now neither goes so far, nor rises so faintly, as when the Plant is not cut: insomuch that annual Plants, if seasonably cut, and suffered to come up still young, will last more Years than one; as Lettuce, Purslane, Cucumber, and the like. And for great Trees, nearly all over-grown ones in Church-yards, or adjacent to ancient Buildings, are Pollards, or Dottards; and not at their full height.

Experiments for making Plants more durable.

5. Experiment should be made, to render Plants more lasting than their ordinary Period; as to make a Stalk of Wheat, &c. last a whole Year; so as that the Winter may not kill it: for we speak only of prolonging the natural Period. I conceive, that whatever makes an Herb come later than at its time, will make it last longer. It were proper to try this in a Stalk of Wheat, set in the Shade, and encompassed with a Case of Wood, not touching the Straw, to keep out the open Air.

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^r On this depends the Advantage of *Pruning*; which, if skilfully performed, always adds new Life and Vigour to the Tree.

^f Consult, upon this whole *Article*, Mr. Evelyn's *Sylva*.

S E C T. XV.

Of the different Figures of Plants.

1. **T**REES and Herbs keep no Order, and are not figured in the Growth of their Boughs and Branches; because the Sap being restrained in the Bark, breaks not forth in the Bodies of Trees, and Stalks of Herbs, till they begin to branch; and when they make an Eruption, they do it casually, where they find best way in the Bark. 'Tis true, some Trees are more scattered in their Boughs; as the Sallow, Warden, Quince, &c. some more pyramidal; as the Pear, Orange, Fir, Service, Lime, &c. some more broad; as the Beech, Hornbeam, &c. and the rest are more indifferent. The Cause of scattering the Boughs, is the hasty breaking forth of the Sap: whence such Trees rise not in a Body of any height; but branch near the Ground. The Cause of the pyramidal Form, is the keeping in of the Sap, long before it branch; and the spending of it, when it begins to branch, by equal degrees. The spreading is caused by the rising of the Sap plentifully, without Expence; and then putting forth speedily at once.

Whence the want of a regular Figure in Vegetables.

2. There are many Herbs, but no Trees, that seem to observe some Order in putting forth their Leaves; as having Joints, Knuckles, or Stops in their Germination; as July-flowers, Pinks, Fennel, Corn, Reeds, and Canes. The Cause whereof is, that the Sap ascending unequally, tires and stops by the way. And it seems they have some Closeness and Hardness in the Stalk; which hinders the Sap from growing up, till it has gathered into a Knot; and so is more urged to put forth. And hence they are most of them hollow, when the Stalk is dry; as in Fennel, Stubble, and Canes.

Whence Plants put forth their Leaves in a certain order.

3. All Flowers have exquisite Figures: and the Flower-Numbers are chiefly five, and four. Primroses, Briar-roses, single Musk-roses, single Pinks, July-flowers, &c. have five Leaves: Lilies, the Flower-deluce, Borage, Bugloss, &c. have four Leaves. But some have numerous Leaves, tho' small; as Marygolds, Trefoil, &c. The Sockets, and Supporters of Flowers are figured; as in the five Brethren of the Rose; the Sockets of July-flowers, &c. All Leaves also are figured; some round, some long, none square, and many jagged on the Sides: which seldom holds in the Leaves of Flowers. For the jaggedness of Pinks and July-flowers seems like the Inequality of the Oak, or Vine-leaves; but they seldom or never have any small Pearls.

Whence the exquisite Figures of Flowers.

S E C T.

¹ See Dr. Sharrock's *History of the Propagation and Improvement of Vegetables*, Pag. 142.

² Consult Mr. Ray, M. Tournesfort; and the *Philosophical Botanists*, upon this Article.

S E C T. XVI.

Of the principal Differences in Plants.

*Why some
Plants blossom
before they
have Leaves.*

1. **S**OME few Plants bear Blossoms before they have Leaves ; as Almonds, Peaches, Cornelians, Black-thorn, &c. but most have some Leaves before they blossom ; as Apples, Pears, Plumbs, Cherries, &c. The Cause is, that those which yield their Blossoms first, have either an acute and sharp Spirit, whence they commonly put forth early in the Spring, and ripen very late ; or else have an oily Juice ; which is apter to put out Flowers than Leaves.

*The Cause of
Evergreens.*

2. Some Plants are green all Winter ; others cast their Leaves. The Ever-greens are Holly, Ivy, Box, Fir, Yew, Cypress, Juniper, Bays, Rosemary, &c. The Cause of their holding green, is the close and compact Substance of their Leaves, and the Pedicles of them. And the Cause of this again is either the viscous Juice of the Plant ; or its Strength and Heat. Of the first sort is Holly ; which is of so viscous a Juice, as to make Bird-lime. The Stalk of Ivy is tough, and not brittle. Fir yields Pitch : Box is a close and heavy Wood ; and Yew is a strong and tough Wood. Of the second sort is Juniper ; which is an odoriferous Wood, and makes a fierce Fire. Bays likewise is a hot and aromatic Wood ; so is Rosemary, for a Shrub. The Density of the Leaves, appears hence ; that they are smooth and shining : as in Bays, Holly, Ivy, Box, &c. or hard and spiry. Trial should be made of grafting Rosemary, Bays, and Box, upon a Holly-Stock ; because these are Plants that grow all the Winter. It were proper to try it also with Grafts of other Trees, either Fruit-Trees or wild ones ; to see whether they will not yield Fruit, or bear Leaves later and longer in the Winter ; because the Sap of Holly puts forth most in the Winter. Perhaps also a Mezereon-Tree grafted upon a Holly, will prove both an earlier and larger Tree.

*Some Trees
that bear no
Flowers yet
produce Fruit,
& vice versa.*

3. Some Plants have no Flower, and yet bear Fruit : some bear Flowers, but no Fruit ; and some again bear neither Flowers nor Fruit. Most of the great Timber-Trees, as Oak, Beech, &c. bear no apparent Flowers : some few Fruit-Trees ; as the Mulberry, Walnut, &c. and some Shrubs, as Juniper, Holly, &c. bear no Flowers. Divers Herbs also have Seeds for their Fruit, yet bear no Flowers ; as Purslane, &c. Those that bear Flowers and no Fruit are few ; as the double Cherry, the Sallow, &c. But for the Cherry, 'tis doubtful whether it be not by Art ; and if so, then Trial should be made, whether Apple, and other Fruit-Trees that blossom, may not be doubled. There are some few that neither bear Fruit nor Flower ; as the Elm, Poplar, Box, &c.

*Why some
Plants grow
erect, and o-
thers creep.*

4. Most Plants shoot still upwards, and support themselves ; whilst others creep along the Ground ; or wind about other Trees or Props, unable to support themselves ; as the Vine, Ivy, Briar, Bryony, Wood-bine, Hop, &c.

The

The Cause is, that all Plants naturally move upwards; but if the Sap rise too fast, it makes a slender Stalk, which will not support the weight: whence the latter sort are all hasty growers.

SECTION XVII.

Of Composts, and Helps for Ground.

1. **T**HE first and most ordinary Help for Ground is Stercoration. Sheep's-dung is one of the best; the next is the Dung of Kine; and thirdly that of Horses; which is held somewhat too hot unless it be mix'd. That of Pigeons for a Garden, or a small piece of Ground, is excellent. The way of applying the Dung to arable Land, is to spread it immediately before Ploughing; so as to plough it in: for if spread long before, the Sun will draw out much of its Fatness. For grazing Ground, the way is to spread it somewhat late, towards Winter; that the Sun may have less power to dry it up.

2. The second kind of Compost is, divers kinds of Earth; as (1.) Marle, (2.) Sea-Sand, (3.) Chalk, (4.) Earth upon Earth, (5.) Pond-Earth; and (6.) Mixtures of them. (1.) Marle is thought the best; as having most Fatness, and not heating the Ground too much. (2.) The next is Sea-Sand; which obtains a particular Virtue from the Salt: for Salt is the first Rudiment of Life*. (3.) Chalk over-heats the Ground a little; and therefore does best upon cold Clay, or moist Grounds. It is a common Error, to think Chalk helps arable Land; but not grazing Ground. The Error proceeds hence, that after chalking of the Ground, they wear it out by many Crops without rest; and then indeed it will afterwards bear little Grass. It were a good Experiment to lay Chalk upon arable Ground a little before Ploughing; and to plough it in as they do Dung: but then it must first be made friable by Rain or lying. (4.) Earth is a Compost to Earth. I knew a great Garden, that had a Field, as it were, poured upon it; and it bore Fruit excellently the first Year: for the Surface of the Earth is always the most fruitful. And Earth so prepared has a double Surface. But such Earth as affords Salt-petre, if procurable without too much Charge, is best. The way to hasten the growth of Salt-petre, is to exclude the Sun, and prevent the growth of Vegetables: and therefore to make a large thatch'd Hovel over some quantity of Ground; or even to plank the Ground over, will produce Salt-petre. (5.) Pond-Earth, or River-Earth is a very good Compost; especially if the Pond have been long uncleaned, and so the Water be not too hungry: and I judge it will be yet better, if mix'd with Chalk.

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3. The

* Many curious Observations, for the improvement of this Article, are supplied by the French Memoirs.

† See Sir Hugh Plat's Jewel-House of Art and Nature, pag. 114, &c.

‡ See Boerhaave's Chemistry, under the Processes upon Sea-Salts.

- A third Kind.* 3. The *third* Help for Ground is procured by means of some other Substances, tho not merely earthy, having a Virtue to fertilize : wherein Ashes excel ; inasmuch that the Countries about *Ætna* and *Vesuvius*, have a kind of amends made them in the exceeding Fertility of the Soil, for the Mischief done them by the Eruptions : which Fertility is caused by the Ashes scatter'd over the Ground. Soot also, tho thin spread in a Field or Garden, is found a very good Compost. Salt is too costly : it has been tried, that mix'd with Seed-Corn, and sown together, it proves serviceable ; and I am of Opinion, that powder'd Chalk, mix'd with Seed-Corn, would do good ; perhaps as much as chalking the Ground all over. As to the steeping of Seeds in several Mixtures with Water, to give them Vigour, and watering Grounds with Compost-water, we have spoke thereto already².
- A fourth Kind.* 4. The *fourth* Help is suffering Vegetables to die into, and so fatten the Ground ; as the Stubble of Corn, especially of Pease. Brakes cast upon the Ground in the beginning of Winter, will make it very fruitful. It were proper also to try whether Leaves swept together, and mix'd with some Chalk and Dung, to give them more Heart, would not make a good Compost ; for there is nothing wasted so much as the Leaves of Trees : and as they lie scatter'd, and without Mixture, they rather make the Ground sour than otherwise².
- A fifth Kind.* 5. The *fifth* Help for Ground is Heat and Warmth. It has been anciently practis'd to burn Heath, Ling and Sedge, with the advantage of the Wind, upon the Ground. We find that the warmth of Walls and Enclosures is an Amendment : so is lying open to the South ; and the folding of Sheep ; as well by their Warmth, as their Compost : and perhaps the covering of Ground with Brakes in the beginning of the Winter, may help by means of the Warmth. Nay, some suspect, that the usual way of gathering Flints in flinty Ground, and laying them on Heaps, is no good Husbandry ; because they would keep the Ground warm.
- A sixth Kind.* 6. The *sixth* Help for Ground is watering ; which may be done two ways ; the one by letting in and shutting out the Water at seasonable Times : for Water let in at some times, if it stay not too long, does good ; but at others, and if it stay too long, hurt. And this serves only for Meadows, adjacent to a River. The other way is, to bring Water from some high Grounds, where there are Springs, into the lower ; carrying it in long Furrows ; and from these Furrows drawing it transverse, to spread the Water : which makes an excellent improvement both for Corn and Grass : tho the Expedient proves the richer, if these hanging Grounds be fruitful ; because the Water thus washes down some of the Fatness of the Earth. Generally where there are great Over-flows in Fens, or the like, the drowning of them in Winter makes the following Summer more fruitful : as keeping the Ground warm, and nourishing it. But the Fenmen hold, that the Sewers may be kept so as to continue the Water too long in the Spring, till the Weeds, and Sedge be grown up ; because then the

² See above *Self*. I.² Has the Experiments of converting Leaves into Manure been fully tried?

the Ground, like a Wood, will keep out the Sun; and so continue the Wet, and never graze well that Year^a.

S E C T. XVIII.

Of the Relations between Plants and inanimate Bodies.

1. **A**LL Bodies have Spirits, and pneumatical Parts: but the principal Differences between animate and inanimate Bodies are two. *The two grand Differences between animate and inanimate Bodies.* The *first*, that the Spirits of animated Things are all contained within themselves, and branched in Veins, and secret Canals, as the Blood is: and in living Creatures, the Spirits have not only Branches, but certain Cells or Seats, where the principal Spirits reside, and whereto the rest resort: but the Spirits in Things inanimate are shut up, and cut off by the tangible Parts, and are impervious one to another, as Air in Snow. The *second* grand Difference is, that the Spirits of animate Bodies are in some degree kindled, or have a fine commixture of Flame, and an aerial Substance: but inanimate Bodies have not their Spirits inflamed, or kindled. And this Difference consists not in the heat or coolness of the Spirits; for *Naptha*, Cloves, and other Spices, have exceeding hot Spirits; much hotter than Oil, Wax, &c. but are not inflamed. And when any of these weak and temperate Bodies come to be inflamed, they gather a much greater Heat than others uninflamed; besides their Light and Motion^b.

2. The secondary Differences proceeding from these two radical ones, *The secondary Differences.* are, *first*, that Plants are figured and determinate; which inanimate Bodies are not: for as far as the Spirit is able to spread and continue itself, so far goes the Figure, and is then determined. *Secondly*, Plants are nourished; but inanimate Bodies are not: the latter have an Accretion, but no Alimentation. *Thirdly*, Plants have a Period of Life; which inanimate Bodies have not. And, *Fourthly*, they have a Succession and Propagation of their Kind; which inanimate Bodies have not.

3. The Differences between Plants and Fossils, besides those already mention'd, are these. (1.) Metals are more durable than Plants: (2.) More solid and hard: (3.) They are wholly subterraneous; whereas Plants are part above Ground and part below. Few Creatures participate both of the Nature of Plants and Metals. Coral is one of the nearest; and another is Vitriol; which is aptest to sprout with Moisture. *The Differences between Plants and Fossils.*

4. There is another particular Affinity between Plants and Mouldiness, or Putrefaction; for all Putrefaction, if not dissolved in Arefaction, will determine into Plants, or living Creatures, bred by Putrefaction: Moss, Mushrooms, Agarick, &c. appear to be but the Mouldiness of the Ground, Walls, Trees and the like. Flesh, Fish, Plants, and many other Things,

O o 2

after

^a Let the other kinds of Amendment be here enumerated. See Mr. Evelyn's *Terra*, and the *Philosophical Transactions*. See also Sir Hugh Plat's *Jewel-House of Art and Nature*.

^b See more to this purpose in the Author's *History of Life and Death, sub finem*.

after Mouldiness, or Corruption, produce Worms. These Putrefactions, notwithstanding their Affinity to Plants, have this Difference from them; that they are without Succession or Propagation; tho they are nourished, have a period of Life, and likewise some Figure. A cut Citron, being left in a close Room, for three summer Months, there were grown out of the Pith, Tufts of Hairs an Inch long, with little black Heads, as if they would have been some Herb ^c.

S E C T. XIX.

Of the Relations between Plants and Animals.

*The radical
and secondary
Differences be-
twixt Plants
and Animals.*

1. **T**HE Affinities and Differences between Plants and Animals are these. They have both of them Spirits continued, branched, and inflamed. But, (1.) in living Creatures, the Spirits have a Cell, or Seat; which Plants have not. And, (2.) the Spirits of living Creatures hold more Flame, than the Spirits of Plants. And these two are the radical Differences ^d. The secondary Differences are as follow. (1.) Plants are fix'd to the Earth; whereas Animals are severed from it. (2.) Animals have local Motion; which Plants have not. (3.) Animals are nourished from their upper Parts, the Mouth chiefly; but Plants from below. (4.) Plants have their Seed and seminal Parts uppermost; Animals lowermost: whence it was philosophically said, that Man is like an inverted Plant: for the Root in Plants is as the Head in Animals. (5.) Animals have a more exact Figure than Plants. (6.) They have a greater diversity of Organs within their Bodies, and internal Figures, than Plants. (7.) They have Sense; which Plants have not. (8.) They have voluntary Motion; which Plants have not.

*As Male and
Female kind in
Plants.*

2. The different Sexes in Plants, are often distinguish'd by Name: as Male-piony, Female-piony; Male-rosemary, Female-rosemary; He-holly, She-holly, &c. but Generation by Copulation extends not to Vegetables. But perhaps a *Binary* of stronger and weaker, like Masculine and Feminine, holds in all living Bodies: tho 'tis sometimes confounded; as in Creatures bred of Putrefaction, where no Marks of Distinction appear: and 'tis sometimes doubled, as in Hermaphrodites: but generally there are degrees of strength in all Species. The Intermediates between Plants and Animals, are chiefly

^c Here seems to be a considerable Foundation laid for the Natural History of Mouldiness; which the Microscope shews to be a kind of Wood, or Grove of Plants. But this requires to be prosecuted, in Fruits, fermented Liquors, and all Vegetable, Animal, and many Mineral Subjects.

^d This may deserve a very strict Examination. See the Author's *History of Life and Death*; and compare the Doctrine there delivered to this purpose, with Mr. Boyle's Experiments upon Flame and Air.

chiefly fix'd, and have no local Motion of removal, tho they have Motion in their Parts ; as Oysters, Cockles, and the like ^c.

S E C T. XX.

Miscellaneous Experiments and Observations upon the Subject.

1. **S**CARCE any Vegetables have Branches without Leaves, except *Plants without Leaves.* Coral. But in the Desarts of *S. Macario in Egypt*, is a long, leafless, brown Plant, and branched like Coral, only closing at the top ; which being set in Water within Doors, spreads and displays strangely. The Natives have a superstitious Belief that it helps Delivery.

2. The *Indian Fig* bows its Branches down so low in one Year, as to take *The Indian Fig growing from its own Branches.* Root again ; and thus multiplies from Root to Root, making a kind of Wood. This may proceed from the Plenty of the Sap, and the Softness of the Stalk ; which makes the Bough, being over-laden, and not strongly upheld, weigh down. Its Leaves are as broad as a little Target ; but the Fruit no bigger than Beans : for the continual Shade increases the Leaves, but stints the Fruit ; which nevertheless is of a pleasant Taste. And this proceeds from the supple ness and gentleness of the Juice of the Plant ; which also makes the Boughs flexible.

3. Perhaps in some Plants, the Sap rises so fast, as to have no leisure to divide into many Leaves ; or put forth much Stalk to the Fruit. With us Trees generally have small Leaves in Comparifon. The Fig-Tree has the largest ; and next to that the Vine, Mulberry, and Sycamore : the least are those of the Willow, Birch, and Thorn. But there are Plants with far greater Leaves than any Tree ; as the Bur, Gourd, Cucumber, Colewort, &c. The *Cause* is, the hasty and plentiful rising of the Sap. *Whence large and small Leaves in Plants.*

4. There are three Things in use for sweetness ; *Sugar, Honey, and Manna.* *Sugar* was scarce known to the Ancients, and little used ^e. 'Tis found in Canes. *Honey* is made, or gathered by the Bee ; but I have heard, that the Labour of the Bee is about the Wax ; and that in the beginning of May, Honey-Combs have been found empty of Honey ; and within a Fortnight, when the sweet Dews fall, fill'd like a Cellar. 'Tis probable that the Sap and Tears of some Trees are sweet ^g. Perhaps also *some sweet Juices, fit for many Uses, may be boiled out of Fruits, to the thickness of Honey or Sugar.* Let the means be enquired into. The likeliest Matters are Raisins, Figs, Currans, &c. ^h. *Whether a Saccharine Substance be not obtainable from certain Vegetables.*

5. Some

^c There are several Particulars relating to this Subject, collected together in *Boerhaave's Chemistry*.

^f See the Article SUGAR.

^g As the Birch, the Sycamore, &c. See the *Philosophical Transactions*.

^h To these may be added malted Corn, Nuts, Pulse, and every other Vegetable capable of being malted. What is the best way of reducing the sweet Substance of these Commodities to an actual Sugar ? Let the common Method of making *Sugar* from the Raw Juice be tried. See the Article SUGAR. Consider of Plantations of Hips, Parsnips, Fennel, Maple, &c. and any other cheap Vegetable, that yields a saccharine Juice.

The Vegetables
that afford
Clothing, &c.

5. Some Plants are used for Raiment ; as Hemp, Flax, Cotton, Nettles, and growing Silk : they also make Cables of the Bark of the Lime-Tree. 'Tis the Stalk that commonly makes the matter of the Thread ; and sometimes the Down that grows a-top ⁱ.

Three different
Kinds of
Roots.

6. Some Plants have a mossy or downy Root ; and some have a number of Threads, like Beards ; as Mandrakes, whereof Impostors make an ugly Image, giving it a Face at the top, and leaving these Strings to make a broad Beard down to the Foot. There is also a kind of Nard in *Crete*, having a hairy Root. So that there are bulbous Roots, fibrous Roots, and hairy Roots. In the *bulbous*, perhaps, the Sap hastens most to the Air and Sun : but in the *fibrous*, delights more in the Earth ; the hairy being a middle Nature between both ; that besides shooting both upwards and downwards, puts forth in a round.

Some Tears of
Trees combed
from the
Beards of
Goats.

7. Some Tears of Trees are combed from the Beards of Goats : for when the Goats bite and crop, especially in the Morning Dews, the Tear comes out and hangs upon their Beards. Of this sort is a kind of *Labdanum*.

The way of
transposing
exotick Roots.

8. In order to remove foreign Roots to a great Distance, let them be close packed in earthen Vessels. But if the Vessels be not very large, make some Holes in the bottom ; to give refreshment to the Roots, which otherwise will decay and suffocate.

Uncommon
Properties of
the ancient
Cinnamon.

9. The ancient *Cinnamon* was, of all Plants while it grew, the dryest ^k ; and the Things known to comfort other Plants, made this more steril ; for in Showers it prosper'd worst : it also grew among Bushes of other Kinds, where Plants do not commonly thrive : neither did it love the Sun. There might be one Cause of all these Effects ; viz. the sparing Nourishment it required. *Quære*, how far *Cassia*, which is now the substitute for Cinnamon, participates of these Properties ^l ?

Large Vines
known to the
Ancients.

10. There were anciently Vines of much larger Bodies than we are acquainted with ; so that Cups, and an Image of *Jupiter* has been made of them. But perhaps these were Wild-Vines ; the Vines used for Wine, being so often cut, dug and dress'd, that their Sap goes into the Grapes ; whence the Stalk cannot increase much in Bulk ^m. The Wood of Vines is very durable, without rotting. And tho' no Tree, while green, has such brittle Twigs ; yet the Wood dried is extremely tough : and was used by the *Roman Captains* for their Cudgels.

Vines running
along the
Ground.

11. 'Tis reported, that in some places, Vines are suffer'd to grow like Herbs, spreading upon the Ground ; and that the Grapes of those Vines are very

ⁱ All the Vegetables should be enumerated that will bear the Hatchel.

^k The great apparent dryness of the common *Cinnamon* has perhaps given occasion to suspect that this fine Aromatic cannot, in *England*, be distilled, for its Oil, to Advantage. But those who are skilful in the drawing of essential Oils, may find the contrary upon Trial.

^l Wherein did the ancient *Cinnamon* differ from the modern ? *Cassia Lignea* differs considerably from the present Cinnamon ; particularly in abounding with a mucilaginous part ; which *Cinnamon* is without.

^m Is there not also an essential difference betwixt the two Species ?

very large. It were proper to try whether Plants usually sustain'd by Props, will not bear larger Leaves and Fruits, if laid along the Ground ; as Hops, Ivy, Woodbine, &c.

12. It is *credibly reported*, that to lay good store of Grape-stones about the Root of a Vine, will make the Vine come earlier, and prosper better. *The improvement of Vines.* This may be tried with other Kernels, laid about the Root of a Plant of the same kind ; as Figs, Apples, &c. The Cause may be, that the Kernels attract the Juices fit to nourish the Tree, as these would be Trees themselves, if there were no Root ; but the Root, being of greater Strength, draws the Nourishment from them.

13. To preserve Quinces, Apples, &c. plunge them in Honey ; but because Honey may give them an over-luscious Taste, try Sugar, or Syrup of Wine, boil'd to a due height. This should likewise be tried in Oranges, Lemmons, and Pomegranates. The Conservation of Fruit should also be tried in Vessels fill'd with fine Sand, or powder of Chalk ; or in Flower ; the Dust of Oak-wood, &c. Fruits intended for long keeping, must be gathered before they are full ripe ; and in a fair dry Day, towards Noon ; the Wind blowing not South ; the Moon being under the Earth ; and in her Decrease. *The means of preserving Fruit.*

14. If Grapes be suspended in an empty Vessel well stopped, and set in a dry place, 'tis said they will keep long ; but better, 'tis thought, in a Vessel half full of Wine ; provided the Grapes do not touch the Wine. 'Tis reported that preserving the Stalk, helps to preserve the Grape ; especially if some of the Stock be took off along with the Branches ; or the Stalk be put into the Pith of Elder ; the Elder not touching the Fruit. *To preserve Grapes.*

15. Some Herbs and Plants are good to eat raw ; as Lettuce, Endive, Purslane, Cresses, Cucumbers, Radish, &c. others only after they are boil'd ; as Parsley, Clary, Asparagus, &c. but many Herbs are not esculent at all ; as Wormwood, Grass, Centaury, Hyssop, Lavender, &c. The Herbs that are not esculent, want two Properties wherein Nourishment consists ; viz. Fatness and Sweetness ; and have bitter and overstrong Tastes, or a Juice so crude as not to be ripen'd to the degree of Nourishment. Herbs and Plants that are esculent when raw, have a Fatness, or Sweetness ; such are Onions, Lettuce, &c. But it must be such a Fatness as is not too gross,

* Does it make the Vine prosper better than any other Manure ?

° This Syrup of Wine, I conceive, is made by boiling Wine to the Consistence of a Syrup ; either with or without the addition of Sugar. The Remains after the Distillation of Brandy may be thus treated to Advantage. But let the Operation be perform'd in *Balneo Mariae* ; whereby an excellent Preparation will be obtained ; of Service both in Food and Physick.

° These are serviceable Methods of preserving either Fruits or Flowers.

° There are numerous Expedients of this Kind. The way in France is to hang the Grapes in a dry Room upon Lines, so that no two Bunches may touch : and thus they keep them long moist, and tolerably fresh. This Method seems taken from that other of preserving them upon the Vine ; where they will hang long, if the Vine be housed, or secured from the injuries of the Weather.

° Let this be examined in the inductive Method, to see if an Axiom can be form'd upon it.

grofs, and overloading to the Stomach : for Parfnips and Leeks have Fatnefs ; but it is too grofs and heavy without boiling. This Fatnefs muft alfo be in a Substance fomewhat tender ; for Wheat, Barley, Artichokes, &c. are no good Nourifhment, till they have pafs'd the Fire ; which ripens and makes them foft, tender, and efculent. Radifh, Tarragon, and the like, are rather for Sauce than Nourifhment. And fome Herbs, which are not efculent, are, however, potulent ; as Hops, Broom, &c. *Quære*, What Herbs are good for Drink, befides thefe two ? For it may eafe the Charge of Brewing, if they make Beer require lefs Malt, or render it more durable [†].

*What parts of
Plants are
nutrimental.*

16. The parts of Plants fit to nourifh the Body are Seeds, Roots, and Fruits ; but chiefly Seeds and Roots. Leaves, Flowers, and Stalks, yield little or no Nourifhment. The *Caufe* is, that Roots, Seeds, and Fruits have more of the oily Substance ; and Leaves, Flowers and Stalks, more of the watry. Again, they are more concocted ; for the Root which always continues in the Earth, is ftill concocted by the Earth ; and Fruits, and Grains, are half a Year, or more, in concocting ; whereas Leaves are out and perfect in a Month [‡].

*Why fome
Plants are
ftronger in the
Seed, and o-
thers in the
Root.*

17. Plants are ufually ftronger in their Seed, both to the Taffe and Smell, than in the Leaf and Root. The *Caufe* is, that in Plants not of a fierce and eager Spirit, the Virtue is increafed by Concoction and Maturation, which is always moft in the Seed ; but in Plants of a fierce and eager Spirit, they are ftronger, whilft the Spirit is inclofed in the Root : and the Spirits do but weaken and difsipate when they come to the Air and Sun ; as we find in Onions, Garlick, Dragon, &c. Nay, fome Plants have their Roots very hot and aromatic, yet their Seeds rather infipid ; as Ginger : the Heat of thefe Plants being very difsipable, which under the Earth is kept in ; but exhales when it comes to the Air [§].

*Fruits divided
into watry,
oily, and fweet.*

18. The Juices of Fruits are either watry or oily. Among the watry come all the Fruits that afford potable Liquors ; as the Grape, the Apple, the Pear, the Cherry, &c. And there are fome others, which, tho not ufed for Drink, yet appear of the fame Nature ; as Plumbs, Services, Mulberries, Rasperies, Oranges, Lemmons, &c. and thefe Juices that are too flefhy to make Drink by Expreffion, may do it by the admixture of Water [¶]. Perhaps Hips, and Briar-berries would do the like [¶]. The Fruits
that

[†] The Brewers are faid to ufe Wormwood, Gentian, &c. inftead of Hops ; Treacle inftead of Malt ; and, to give an additional Strength, *Grains of Paradife*.

[‡] This Matter requires a farther Enquiry, and Verification.

[§] See the *Processes relating to Vegetables*, in Boerhaave's *Chemiftry*.

[¶] *Poculag; admittis imitantur vitæ forbis.*

[¶] Thefe are Intimations of confiderable Service. All kinds of Plumbs, tho'ever fo hard and flefhy ; being bruifed and mixed with Water, ferment kindly ; and with Skill make tolerable Wines. Hips are an excellent Fruit for this purpofe : but Blackberries make a coarfe Wine ; tho a good Brandy. Certainly it were practicable to have Plantations of fuch Fruit-Trees in England, as fhould afford us *Wines*, equal in Goodnefs to thefe of foreign Growth. Some have tolerable Succefs with the *Burgundy Grape* ; fome with the *Morelli Cherry* ; fome
with

that have oily Juices, are Olives, Almonds, Nuts, Pine-apples, &c. and their Juices are all inflammable*. Observe likewise, that some of the watry Juices, after Fermentation, will burn and flame; as Wine. There is a third kind of Fruit that is sweet, without either sharpness or oiliness: such as the Fig, the Date †, &c.

19. It has been noted, that most Trees, especially those that bear *Mast*, are fruitful but once in two Years: the *Cause* is, the Expence of Sap; for many Orchard Trees, well cultured, will bear several Years together ‡.

Why Mast-Trees bear but once in two Years.

20. No Tree bears so many bastard Fruits as the Oak: for besides the Acorn, it bears Galls, Oak-Apples, certain Oak-Nuts, which are inflammable; and certain Oak-Berries, sticking close to the body of the Tree without Stalk. It bears also Mistletoe, tho rarely §. The *Cause* of this may be, the closeness and solidity of the Wood, and Pith of the Oak; whence different Juices make different Eruptions. And therefore, to produce Super-plants, we must give the Sap a plentiful Rise, and a hard Issue ¶.

Why the Oak bears many bastard Fruits.

21. There are two Excrecences of Trees; both of them growing in the Nature of Mushrooms: the *one* the *Romans* call'd *Boletus*; which grows upon the Roots of Oaks, and was a Dainty of their Table; the *other* is medicinal, and call'd *Agarick*, which grows upon the Oak; and is also affirmed to grow at the Root. I conceive that many Excrecences of Trees grow chiefly where the Tree is dead, or faded: the Sap there corrupting into some preternatural Substance §.

Two Mushroom-like Excrecencies of Trees.

22. Most Trees bear best on the lower Boughs; as Oaks, Figs, Walnuts, Pears, &c. but some bear best on the top; as Crabs, &c. Those that bear best below, are such as Shade befriends; for generally Fruit-Trees bear best below: because the Sap has but a short way to go §. But Shade hinders the lower Boughs; except in such Trees as delight in Shade, or bear it well. Those therefore are either strong Trees, as the Oak; or have large Leaves, as the Walnut and Fig; or else they grow *pyramidal* as the Pear. But if they require much Sun, they bear best on the top; as in Crabs, Apples, Plumbs, &c.

The Cause of Trees bearing some better above, and some best below.

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P p

23. Some

with the white Curran; some with the white Eder, &c. And, perhaps, by a proper Expedient our better kinds of Cyder are convertible into Wines, not to be distinguished from the best Wines of France or Portugal, whether Red or White. See Mr. *Ausien's Treatise of Fruit-Trees*, the *Vinetum Britannicum*, *Boerhaave's Chemistry*, &c.

* The Plants that afford Oil should be diligently sought after; on account of their great Utility. Consider of Beech-Mast, the Sun-Flower-Seed, Mustard-Seed, &c. for this purpose.

† These also should be enumerated; as being not only Food, but capable of affording Drink by Fermentation.

‡ Is this Cause justly assigned?

§ See above Sect. X. 18.

¶ If the Cause be just; so will the Rule: and observe, in general, that the Discovery of Causes is the finding of Rules. This has been intimated more than once already; but the importance of the thing may allow of a Repetition.

§ This Subject is touched above: See Sect. X. See also more to the same purpose in the *Philosophical Transactions*, N° 330.

§ This should seem to be meant of Wall-Trees, rather than Standards.

§ Is there not some more latent Cause of the Effect? See the *French Memoirs*, and *Philosophical Transactions*.

Why some Trees
bear best when
old.

23. Some Trees bear best when they begin to be old; as Almonds, Pears, Vines, and all the Trees that yield Mast. The Cause is, that all Trees bearing Mast, have an oily Fruit; and young Trees a more watery Juice, and less concocted: and of this kind is the Almond. The Pear likewise, tho it be not oily, yet requires much Sap, and well concocted; for 'tis a heavy and solid Fruit; much more so than Apples, Plumbs, &c. The Vine bears more Grapes when it is young; but Grapes that make the best Wines, when it is old: the Juice being then better concocted. And we see Wine is inflammable; so that it has a kind of Oiliness: but most Trees bear best when young.

Whence milky
Juices in
Plants.

24. Some Plants ouze out a Milk when cut; as Figs, Sow-thistles, Spurge, &c. The Cause may be, a tendency to Putrefaction: for these are all acrimonious; tho one would expect them mild. If you write upon Paper with the Milk of the Fig-tree, the Letters will remain invisible till the Paper be held to the Fire, and then they grow brown; which shews the Juice to be sharp or fretting^c. Lettuce is thought poisonous, when so old as to have Milk; Spurge is a kind of Poison in itself; and Sow-thistles, tho Rabbits eat them, yet Sheep and Cattle will not: besides, the Milk thereof rubbed upon Warts, soon wears them away; which shews the Milk to be corrosive. Wheat also, and other Corn, if taken from the Ground before they sprout, are full of Milk; and the beginning of Germination is always a kind of Putrefaction^e. Euphorbium also contains a Milk, tho not very white, but of a great Acrimony; and Celandine a yellow acrimonious Milk, that cleanses the Eyes, and is good in Cataracts^f.

Few red Juices
in Plants.

25. There is scarce a Plant that yields a red Juice in the Blade or Ear, except that which affords the *Sanguis Draconis*; and grows chiefly in the Island *Socotra*. The Herb *Amaranthus*, indeed, is red all over; and Brasil is red in the Wood: so is red Sanders. The *Sanguis Draconis* Tree grows in the Form of a Sugar-loaf. Perhaps the Sap of that Plant concocts in the Body of the Tree. For Grapes and Pomegranates are red in the Juice^g, but green in the Tear: and this makes the *Sanguis Draconis* Tree less towards the Top; because the Juice does not rise quick; and is, besides, very astringent, and therefore of slow Motion.

Sweet Moss.

26. 'Tis said, that sweet Moss sometimes grows upon the Poplar as well as the Apple-tree; and yet the Poplar-tree has a smooth Bark, and little Moss. The Moss of the *Larix* Tree, also burns sweet, and sparkles in the burning. Enquire about the Mosses of odoriferous Trees, as Cedar, Cypress, Lignum-Aloes, &c.

Whence Hem-
lock procures
an easy Death.

27. Hemlock is noted for procuring the least painful Death; and therefore, out of humanity, was used at *Athens*, for executing capital Offenders. The Poison of the Asp has some affinity with this Plant. The Cause is, that the Torment of Death being chiefly produced by the struggle of the Spirits;

^c On what Principle is the Consequence founded?

^e Observe it particularly in Malting, where the Operation passes wholly under the Eye.

^f Compare this with the Account given of Vegetables in *Boerhaave's Chemistry*.

^g That is, upon Pressure.

Spirits : the cold Vapours of these quench the Spirits by degrees ; as in the Death of an extreme old Man. I conceive it less painful than *Opium* ; because *Opium* has hot Parts intermixed with it ¹.

28. Some Fruits are sweet before they are ripe ; as Myrobalans, Fennel-seed, &c. some never ripen to be sweet ; as Tamarinds, Barberries, Sloes, &c. The Cause is, that the former have much subtil Heat, which gives early Sweetness ; whilst the latter have a cold and acid Juice, which no heat of the Sun can sweeten. But the Myrobalan has Parts of contrary Natures ; being both sweet and astringent ^k.

29. Few Herbs have a salt Taste ; but the Blood of living Creatures is saline. The Cause may be hence, that Salt, tho' the Rudiment of Life, yet the original Taste does not remain in Plants ; for we have them bitter, sour, sweet, biting, but seldom salt : whilst, in Animals, all those high Tastes may happen to be in the Humours, but seldom in the Flesh, or Substance ; this being of a more oily Nature, which is not very susceptible of such Tastes. The Saltness of Blood is but a light and secret Saltness : and even among Plants, some participate of Saltness ; as Sea-weed, Samphire, Scurvy-grass, &c. 'Tis certain, that out of the Ashes of all Plants a Salt is extracted for medicinal Use ^l.

30. Barley being steeped three Days in Water, then drained and turned upon a dry Floor, will sprout half an Inch long ; and if let alone without turning, it will shoot much more, till the heart be out. Wheat does the same. Try it also with Pease and Beans ^m. This Experiment should be driven farther : for it appears already, that the Earth is not necessary to the first sprouting of Plants ; and Rose-buds set in Water will blow : therefore try whether the Sprouts of such Grains may not be raised to an Herb, or Flower, with Water only, or some small Commixture of Earth ; for if they may, it should seem they will grow much faster in Water than in Earth : the Nourishment being easier drawn out of Water, than out of Earth. Try the same Experiment with Roots as well as Grains : for example, steep a Turnip a-while, then dry it, and see whether it will sprout ⁿ.

31. Malt in the drenching will swell, so as, after sprouting and drying upon the Kiln, to gain at least a Bushel in eight ; yet the Sprouts are rubbed

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¹ Tho' the Description given of the ancient Hemlock by *Dioscorides*, may seem to agree with ours ; perhaps the two Plants differ greatly in Efficacy. 'Tis said that several have eaten of our Hemlock without any ill Effect. What affinity has the *Oenanthe Cicuta facie* with the ancient Hemlock ? See *Wesfer* upon the Subject.

^k Let a nearer Approximation be made to the Cause.

^l See the Processes upon Vegetables in *Boerhaave's Chemistry*.

^m They do the same.

ⁿ Here is a noble Direction given for the Application of the first part of the common Process of Malting, to other vegetable Subjects : and how far this Experiment may be carried, and to what Advantage, seems little apprehended. Is it not applicable to Nuts, Pulse, and Roots, as well as to all sorts of Grain, even Rice, Millet, &c ? See, in the *Philosophical Transactions*, a Method of Making that hard and gummy Substance, *Indian Wheat*, by suffering it first to sprout in the Ground ; then drying it upon the Kiln. *Lowth. Abridg.* Vol. II. pag. 630—634, or Numb. 142.

Why some Fruits ripen sweet, and others not.

Why some Plants have a saline Taste.

The Experiment of Malting to be extended.

The Enquiry for introducing Sweetness into Bodies recommended.

rubbed off; and there will be a Bushel of Dust, besides the Malt. This, I suppose, happens not only from the loose lying of the Parts, but from some addition of Substance, drawn from the Water in which it was steeped^o. Malt acquires a Sweetness in the Operation; as appears yet more in the Wort. *The Edulcoration of things should be tried to the full*; as tending to Nourishment^p: and the making of things inalimental, to become alimental, may be of great profit, in producing new kinds of Provision^q.

Why the Skin of the Onion rises.

32. Most Seeds in growing leave their Husk, or Rind, about the Root: but the Onion carries it up; whence it appears like a Cap on the Top of the young Onion. The *Cause* may be, that its Skin, or Husk, is not easy to break; as we see, in peeling of Onions, the Skin is a clinging Substance.

Whence some Plants are curled.

33. Plants that have curled Leaves, abound with Moisture; which comes so fast on, that they cannot spread themselves plain, but must needs collect together. The weakest kind of Curling is Roughness; as in Clary and Burr: the second is curling on the Sides; as in Lettuce, and young Cabbage: and the third is folding into an Head; as in Cabbage, full grown, and Cabbage-lettuce.

Fir and Pine sparkle in breaking.

34. 'Tis said, that Fir and Pine, especially if old and putrefied, tho they shine not, as some rotten Woods do; yet, in sudden breaking, will sparkle like hard Sugar.

Why some Trees strike deep Roots.

35. Some Roots of Trees strike deep into the Ground; as the Oak, Pine, Fir, &c. some spread more towards the Surface; as the Ash, Cypress, Olive, &c. The *Cause* of this may be, that such Trees as love the Sun, unwillingly descend far into the Earth, and therefore commonly shoot up much; for, their Desire of approach to the Sun, makes them spread the less in their Body. And the same Reason, to avoid Recess from the Sun, makes them spread the more under Ground. And we see that some Trees, planted too deep in the Ground, to approach the Sun forsake their first Root, and put out another nearer the Surface of the Earth. We see also, that the Olive is full of an oily Juice; the Ash makes the best Fire, and the Cypress is a hot Tree; but Oak loves the Earth, and therefore grows slowly. Pine, and Fir likewise, have so much Heat in themselves, that they the less require the Sun. There are Herbs also, that have the same Difference: thus the *Morsus Diaboli* strikes its Root down so low, that it cannot be plucked up without breaking^r.

A Branch growing that was bare at the Bottom.

36. A Branch of a Tree being unbarked at the Bottom, and so set in the Ground, has grown; even in such Branches as would not have grown if set with

^o Malsters have a Trick of Over-malting their Barley, in order to make it measure well; but what additional Weight can they give it? or does it naturally acquire any in the Making?

^p See above, § 18.

^q Here is a large Field of Enquiry opened, that reaches to the Subjects both of the Vegetable and Animal Kingdom. The making of Malt and Sugar may serve as capital Instances of the kind, in Vegetable Matters; and, in Animal ones, the Method of converting solid Bones into good Nourishment, is an Experiment by no Means attended to as it deserves.

^r Cannot a nearer Approximation be here made to the Cause?

with the Bark on: and yet a Tree pared round in the Body above ground, will die. The Cause may be, that the unbarked Part draws the Nourishment best; but the Bark continues it only ^f.

37. The Reed, or Cane, is a succulent Plant, that grows only in Water: 'tis hollow; knuckled both Stalk and Root; and being dry, becomes more hard and brittle than other Wood: it puts forth no Boughs, tho many Stalks from one Root. It differs greatly in Size; the smallest being fit for thatching Houses, and stopping the Chinks of Ships better than Glew, or Pitch. The second Size is used for Angle-rods, and Staves; and in China, for beating Offenders upon the Thighs. The different Kinds of them are, the common Reed, the *Cassia Fistularis*, and the Sugar-cane ^g. Of all Plants, it bows the easiest, and rises again. It seems, that of Plants nourished with a Mixture of Earth and Water, it draws most Nourishment from Water; which makes it the smoothest of all others in Bark, and the hollowest in Body ^h.

The Nature and Use of the Reed, or Cane.

38. The Sap of Trees is of different Natures: some more watery and clear, as that of the Vine, Birch, Pear, &c. some thick, as that of the Apple; some gummy, as the Cherry: some frothy, as the Elm; some milky, as the Fig. In Mulberries, the Sap seems to rise chiefly towards the Bark; for if the Tree be cut a little into the Bark, the Sap will issue; but not if the Tree be pierced deeper. The Trees that have the moistest Juices in their Fruit, have commonly the moistest Sap in their Body: for Vines and Pears are very moist; but Apples somewhat more spongy. The Milk of the Fig has the Quality of Rennet, to coagulate Milk: so have certain four Herbs, wherewith they make Cheese in *Lent* ⁱ.

Different Juices in Vegetables.

39. The Timber and Wood are, in some Trees, more clean; and in others more knotty: and it is proper to try it, by speaking at one End, and laying the Ear at the other: for if the Tree be knotty, the Voice will not pass well. Some have the Veins more varied and chambletted; as Oak, and Maple; others more smooth; as Fir, and Walnut: some more easily breed Worms, and Spiders; some more difficultly, as 'tis said of *Irisb* Trees. There are many other Differences that concern their Use: thus Oak, Cedar, and Chestnut, are best for building. Some are best for Plough-timber, as Ash; some for Piers, that are sometimes wet and sometimes dry, as Elm; some for Planchers, as Deal; some for Tables, Cupboards, and Desks, as Wallnuts; some for Ship-timber, as Oaks that grow in moist Grounds; for this makes the Timber tough, and not apt to shiver with Ordnance: wherein *Englisb* and *Irisb* Timber are thought to excel: some for Masts of Ships, as Fir and Pine; because of their Length, Straitness, and Lightness; some for Paling, as Oak; some for Fewel, as Ash: and so of the rest ^k.

The Differences in Timber.

40. The

^f There are many Considerations to this Purpose in the *French Memoirs*.

^g Let the other Species be enumerated.

^h What Certainty is there in this Conjecture?

ⁱ For an Account of the different Juices in different Parts of the same, or different Vegetables, see *Bourhaave's Chemistry*.

^k Consult Mr. Evelyn's *Sylva*. See also the *Acta Eruditorum*, for the Year 1708. pag. 163, &c.

*Different Trees
delight in dif-
ferent Soils.*

40. The Coming of Trees and Plants in certain Regions, and not in others, is sometimes casual; for many Trees have been transplanted, and prospered well. Damask-roses have not been known in *England* above three hundred Years; tho now so common. But the thriving of Plants in certain Soils more than in others, is merely natural. The Fir and the Pine, love Mountains; the Poplar, Willow, Sallow, and Alder, love Rivers and moist Places; the Ash loves Coppices, but is best in Standards alone: Juniper loves Chalk; so do most Fruit-trees: Samphire grows only upon Rocks; Reeds and Osiers, where they are washed with Water: the Vine, loves the sides of Hills, to the South-east Sun ^w, &c.

*The Nature of
the Soil dis-
covered by the
Herbs it pro-
duces.*

41. The Growth of certain Herbs discovers the Nature of the Ground where they grow: thus wild Thyme shews a good Feeding-ground for Cattle; Betony and Strawberries, Grounds fit for Wood; Camomile denotes a mellow Ground, fit for Wheat; Mustard-seed, growing after the Plough, shews a strong Ground for Wheat: Burnet, a good Meadow; and the like ^r.

*More Super-
plants besides
Mistletoe.*

42. Other Plants, besides Mistletoe, grow out of Trees. In *Syria* there is an Herb called *Cassytas*, which, growing out of a tall Tree, winds itself about the Tree; and sometimes about Thorns: a kind of Polypody grows out of Trees, tho it twines not: so does an Herb called *Faunos*, upon the wild Olive; and another, called *Hippophaëstion*, upon the Fuller's-thorn; and is supposed good for the Falling-sickness ^r.

*Some Winds
and Weather,
pernicious to
Trees.*

43. It has been observed, that the cold easterly Winds are prejudicial to Fruit; and that South Winds also are hurtful; especially in Blooming-time; and the more, if followed by Showers. It should seem, that they call forth the Moisture too fast. West Winds are the best. It has also been observed, that green and open Winters prejudice Trees; so that if two or three such Winters come successively, Almonds, and some other Trees, will die. The Cause is, the Earth's exhausting itself too fast.

*Snows ferti-
lize the Earth.*

44. Snows lying long, cause a fruitful Year: for, (1.) they keep in the strength of the Earth: (2.) they water the Earth better than Rain; the Earth sucking, as it were, the Water out of the Snow: and (3.) the moisture of Snow is the finest moisture; as being the Froth of the Water-clouds ^z.

*When Rain is
most service-
able to Fruits.*

45. Showers falling a little before the ripening of Fruits, prove serviceable to all such as are succulent and moist; viz. Vines, Olives, Pomegranates, &c. tho this rather produces plenty than goodness; for the best Wines are made in the driest Vintages. Small Showers are likewise good for Corn, if parching Heats come not upon them: generally Night-showers are better than Day-showers; because the Sun follows not so fast upon them: and we find in watering by Hand, that 'tis best, in Summer time, to water in the Evening.

46. The

^w Could not the *physical Causes* of these Varieties be discovered by proper Sets of Experiments, that should manifest the particular Nature of every Species?

^r All the just Observations of this kind, should be carefully collected.

^y Let all the Instances of this kind be produced. See above *Sett. X.*

^z Are there not other Causes assignable for the Effect? See Mr. Boyle's *History of Cold.*

46. The differences of Earths should be diligently examined. The Earth that easiest softens with Showers is commended; yet some of that kind will be very dry and hard before Rain. The Earth that throws a great Clod from the Plough, is not so good as that which throws up a smaller. The Earth that easily produces Moss, and may be called mouldy, is not good. The Earth that smells well upon the digging, or ploughing, is commended; as containing the Juice of Vegetables almost ready prepared. Poorness of Herbs shews poorness of Earth; and especially if they be dark in Colour: but if the Herbs shew withered, or blasted at the Top, it denotes the Earth to be very cold; so does the mossiness of Trees. Earth where the Grass is soon parched with the Sun, is commonly forced, and barren in its Nature. The tender, cheffom, and mellow Earth, is the best; being mere Mould, between the two Extremes of Clay and Sand; especially if not loamy and binding. The Earth that can scarce be ploughed after Rain, is commonly fruitful; as being cleaving, and full of Juices^z.

The Differences of Soil.

47. 'Tis strange that Dust should make Trees more fruitful, and particularly Vines; upon which they purposely throw it. It should seem that this powdering, when a Shower comes, makes a kind of Soil to the Tree; being Earth and Water finely laid on: and 'tis observed, that Countries where the Fields and Ways are dusty, bear the best Vines.

Why Dust fertilizes.

48. 'Tis recommended, to lay the Stalks and Leaves of Lupins about the Roots of Trees; or to plough them into the Ground where Corn is sowed. To burn the Cuttings of Vines, and cast them upon Land, is very good. And the Ancients generally conceived, it was best to dung the Ground when the West Wind blew, in the Decrease of the Moon; the Earth being then, perhaps, more thirsty and open, to receive the Dung^a.

Other Means of Fertilization.

49. The Grafting of Vines upon Vines seems not now in Use; tho the Ancients had it in three Ways: the *first* was Incision, which is the ordinary manner of Grafting: the *second* was Terebration thro' the middle of the Stock, and putting the Cion therein: and the *third* was, paring two Vines, that grew together, to the Marrow, and binding them close^b.

The ancient Ways of Grafting the Vine.

50. The *Diseases* and *Accidents* of Corn should be enquired into; tho many of them, perhaps, are not to be remedied. (1.) *Mildew* is one of the greatest, which proceeds from closeness of Air; whence it seldom happens in Hills, or large champaign Ground. This cannot otherwise be remedied in Countries of small Enclosure, than by turning the Grounds into larger Fields: which I have known to succeed in some Farms. (2.) The *Shooting up of wild Oats*, into which Corn, especially Barley, is often said to degenerate^c. This happens chiefly from the weakness of the Grain sown; for

The several Diseases of Corn.

^z This is an interesting Subject, that requires a rigorous, philosophical, and chemical Treatment. Let the Analysis of different Earths be made, by simple Elixation, Evaporation, &c. See Mr. Evelyn's *Terra*.

^a Have the sensible Effects of particular Winds upon the Ground been carefully observed, See the Author's *History of Wind*; and Mr. Boyle's *History of Cold*.

^b None of these Ways are said to be effectual; but Vines are easily raised from Slips.

^c But is there any assured Instance of Wheat, or Barley, ever degenerating into Oats?

for if it be either too cold, or mouldy, it will bring forth wild Oats. (3.) The *Satiety of the Ground* ; for if Ground be still sown with the same Corn, the Crop will be poor : therefore, besides the giving rest to the Ground, we must vary the Seed. (4.) The *ill Accidents proceeding from Winds* ; which hurt, both at the flowering, by shaking off the Flowers ; and at the full ripening, by shaking out the Corn. (5.) Another ill Accident is *Drought*, at the Spindling of the Corn ; which with us is rare ; but in hot Countries common ; infomuch that the Word *Calamitas* was first derived from *Calamus* ; when the Corn could not get out of the Stalk. (6.) Another is *Over-wet* at Sowing-time ; which, with us, breeds Dearth ; the Corn in this case never coming up : and frequently they are forced to sow Summer-corn again, where they sowed Winter-corn. (7.) Another bad Accident is, where *Frosts* continue without Snow ; especially in the beginning of the Winter, when the Seed is new sown. (8.) Another Disease is *Worms* ; which sometimes breed in the Root, upon hot Suns and Showers, immediately after the Sowing. And a Worm breeds in the Ear itself ; especially when hot Suns often break out of Clouds. (9.) Another Disease is *Weeds* ; such as either choke or over-shadow the Corn, and bear it down, or starve and deceive it of Nourishment. (10.) Another is *Rankness* of the Corn ; which they remedy by mowing it after 'tis come up ; or putting Sheep into it. (11.) Another is, the *Laying of Corn with great Rains*, near, or in Harvest. (12.) Another bad Accident is, if the Seed happen to have touched Oil, or any fat Thing, which has a Contrariety with the Nourishment of Water^d.

Their Remedies.

51. The Remedies for the Diseases of Corn, are, (1.) To steep the Grain before Sowing in Wine, for a-while. (2.) To mix Seed-corn with Ashes. (3.) To sow at the Wane of the Moon, is thought to make the Corn sound. (4.) It has not been practised, but thought of Use, to make some Mixture in Corn ; as to sow a few Beans with Wheat. (5.) It has been observed, that to sow Corn with Houfeleek is serviceable. (6.) Tho the Grain that touches Oil or Fat, receives Hurt ; yet the steeping of it in the Dregs of Oil, when beginning to putrefy, which they call *Amurca*, is thought to defend it against Worms. (7.) 'Tis reported, that to mow Corn makes the Grain larger ; but emptier, and more husky*.

The Goodness of Seed, how known.

52. Seed of a Year old is found best ; that of two or three Years old bad ; and that which is older, quite barren : tho some Seed and Grains keep better than others. The Corn which lies lowest in the Vanning, is the best : and that which, when broken or bitten, retains a little yellowness, is better than that which is very white.

The Roots of Sorrel strike deep.

53. Of all the Roots of Herbs, that of Sorrel is observed to strike the deepest ; infomuch as to descend four Foot into the Earth : 'tis also the largest

^d The several Diseases of Corn should be sought and described, as fully and accurately in the *Natural History of Vegetation*, as the Diseases of the Body in the Art of Medicine.

^e Much Accuracy, many judicious Experiments, and an ample Stock of close Observations, seem requisite to give the necessary light of Information in this Matter ; for forming *Axioms*, and sure Rules of Practice. See the *Philosophical Transactions* ; the *French Memoirs* ; and the *German Ephemerides*, *passim*.

Root that longest continues fit for setting again. 'Tis a cold acid Herb, that seems to love the Earth, and is not much drawn by the Sun.

54. Some Herbs thrive best when watered with salt Water; viz. Radish, Beet, Rue, Pennyroyal, &c. and this Trial should be extended to some other Herbs, especially those that are strong; as Tarragon, Mustard, Rocket, and the like. *The watering with salt Water recommended.*

55. It seems strange, that poisonous Creatures should affect strong-smelling, and wholesome Herbs; as, that the Snake should love Fennel; the Toad delight under Sage; Frogs under Cinquefoil, &c. but, perhaps, it is rather the Shade, or other Coverture that they affect, than the Virtue of the Herb. *Why venomous Creatures delight in particular Herbs.*

56. 'Twould be very advantageous to discern of what Corn, Herbs, or Fruits, there is likely to be a Plenty, or Scarcity, by certain Signs and Prognosticks, at the beginning of the Year: because such as would come in plenty, might be bargain'd for upon the Ground; as 'tis related of *Thales*; who, to shew how easy it was for a Philosopher to be rich, when he foresaw a great Plenty of Olives, made a Monopoly of them. And for Scarcity, Men may make Profit in keeping the old Store. Long continuance of Snow, is thought to make a fruitful Year; and an early, or very late Winter, a barren Year for Corn: an open and serene Winter, an ill Year of Fruit. Other Prognosticks of the like Nature, are diligently to be enquired after.

57. Great Profit may attend any considerable Improvement in Vegetation: and with this View we would recommend the following Experiments. *Probable Experiments of Profit in Vegetables.*

(1.) The making of Composts of fallen Leaves, River-mud, Earth, and Chalk.

(2.) The inclosing of Earth, or sheltering it from the Weather; to enrich it for Manure, or the yielding of Salt-petre.

(3.) The setting of Wheat and Pease, instead of sowing or scattering them with the Hand.

(4.) The Improvement of Crops, by steeping the Seed in proper saline Liquors.

(5.) The early raising of Peate, Cherries, and Strawberries.

(6.) The strengthening of Earth; that it may yield frequent Returns of Radishes, Parsnips, Turnips, &c.

(7.) The increasing the Roots of Onions, Carrots, Radishes, and others of the esculent Kind.

(8.) The sowing the Seed of Trefoil.

(9.) The planting of Woad.

(10.) The planting of Tobacco.

(11.) Grafting upon the Boughs of old Trees.

(12.) The quick raising of Coppices.

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(13.) The

* The sure Way of obtaining this End, seems somewhat slow and laborious, as depending upon an exact *Meteorological History*; which is not, perhaps, at present, extant. See the Author's *History of Winds*.

- (13.) The planting of Osiers in wet Ground.
 (14.) The preserving of Oranges, Lemmons, Citrons, Pomegranates, all the Summer.
 (15.) The sowing of Fennel.
 (16.) The multiplying and dressing of Artichoaks.
 (17.) The fitting of Hay, Haws, Hips, Trefoil, Bramble-berries, Woodbine, wild Thyme, &c. for brewing, instead of Malt; and the using of Thistles for Hops^z.

And there are numerous Particulars of the like kind.

*Peculiarities in
some Vegeta-
bles.*

58. Some Plants seem to have Singularities, or Particulars different from all others: the Olive has the oily Part only on the out-side; whilst other Fruits have it in the Nut or Kernel. The Fir has, in effect, no Stone, Nut, or Kernel; unless its little Grains be accounted Kernels. The Pomegranate, and Pine-apple, among other Fruits, have only Grains distinct in several Cells. No Herbs have curled Leaves but Cabbage, and Cabbage-Lettuce^h. None have double Leaves, one belonging to the Stalk, another to the Fruit or Seed, but the Artichoak. No Flower has the same kind of Spread as the Woodbind. This is a large field of Contemplation; for it shews, that, in the Production of some Species, there is frequently a composition of Matter that may be greatly diversified; in others, a Composition that happens rarely, and admits of little Variety. So likewise, among Beasts; Dogs have a Resemblance with Wolves and Foxes; Horses with Asles; Hares with Coneys, &c. So among Birds: Kites and Kestrels have a Resemblance to Hawks; common Doves to Ring-doves and Turtles; Black-birds to Thrushes; Crows to Ravens; Daws to Choughs, &c. But Elephants, and Swine, among Beasts; the Bird of Paradise, and the Peacock, among Birds, and some few others, have scarce any other Species like them.

Conclusion.

59. We leave the *Description of Plants and their Virtues* to HERBALS, or the like Books of *Natural History*; wherein Men have shewn great Diligence, even to a degree of *Curiosity*: for our *Experiments* are only such as constantly tend to the DISCOVERY OF CAUSES, and the RAISING OF AXIOMS. Tho we are not ignorant that some, both *ancient* and *modern Writers*, have also endeavoured to tread this Path: But, to say the truth, their CAUSES and AXIOMS, are full of *Imagination*; and so infected with received and current *Theories*, as, in reality, to *corrupt Experience*, and not digest and ripen itⁱ.

VENERY.

^z Here appear to be several useful Hints proposed, and a much greater number intimated. If it were to the present Purpose, we could offer several Considerations, and a Set of Experiments, that might add Light and Confirmation to these Thoughts. But that would carry us too far beyond the Design of these Notes; which is not to *execute*, but merely to *indicate*.

^h Consult the Botanists for others.

ⁱ The Subject of Vegetation has been considerably cultivated since the Time of our Author; but seems still capable of very great Improvement. It were needless here to refer to the common Writers upon *Agriculture*, *Horticulture*, and *Botany*; few of these seem to have understood the Meaning of the foregoing Enquiry; or beginning of a *Natural and Experi-*

VENERY.

1. **I**T has been observed, that profuse VenerY dims the Sight; yet Eunuchs also, are dim-sighted. The Cause, in the former, is expence of Spirits; in the latter, over-moisture of the Brain: which thickens the visual Spirits, and obstructs their Passage; as appears by the decay of Sight in Age; where the Diminution also of the Spirits concurs as another Cause. Blindness likewise proceeds from Rheums and Cataracts. Now in Eunuchs, there are all the Signs of Moisture; as swelling of the Thighs, looseness of the Belly, smoothness of the Skin, &c.

Why profuse VenerY weakens the Eyes.

2. The Pleasure in VenerY is the greatest of sensible Pleasures; and im- properly compared to Itching; tho that also be pleasing to the Touch. But the Cause lies deep. All the Organs of the Senses qualify the Motions of the Spirits; and make so many several Species of Motions, and Pleasures or Displeasures, as there are Diversities of Organs. The Instruments of Sight, Hearing, Taste and Smell, are different in their Make; so are the Parts of Generation. Therefore Scaliger did well to constitute the Pleasure of Generation a sixth Sense. And if there were any other different Organs, and qualified Perforations, for the Spirits to pass; we should have more than five Senses. Perhaps some Beasts and Birds have Senses that we have not; and the very Scent of Dogs, is almost a Sense by itself¹. Again, the Pleasures of the Touch are greater and deeper than those of the other Senses; as we find in warming upon Cold, or cooling upon Heat: for as the Pain of Touch is greater than the Offences of the other Senses; so are the Pleasures. 'Tis true, the affecting of the Spirits immediately, and as it were without an Organ, gives the greatest Pleasure. This happens but in two things; *sweet Odours* and *Wine*. We see the great and sudden Effect of Odours, in recovering Persons that faint: and 'tis certain, that the Pleasure of Drunkenness comes next to the Pleasure of *Venus*. Great Joys, likewise, make the Spirits move and touch themselves; and the Pleasure in VenerY is somewhat of the same kind.

VenerY a sixth Sense.

3. It has been always observed, that Men are more inclined to VenerY in the Winter, and Women in the Summer^m: for the Spirits in a Body more hot and dry, as those of Men, are by the Summer more exhaled; and in Winter more condensed: but in cold and moist Bodies, as those of Women, the Summer cherishes the Spirits, and excites them; whereas

Why Men are most given to VenerY in the Winter.

Qq 2

the

mental History of Vegetation; with a View to the Discovery of Causes and Axioms. Those who desire to continue the Design, may do well to consult the *Philosophical Transactions*; the *French Memoirs*; the *German Ephemerides*; *Malpighi*, and *Dr. Grew's Anatomy of Plants*: *Mr. Evelyn's Pomona*, *Sylva*, & *Terra*; *Boerhaave's Chemistry*; and *Mr. Hales's Vegetable Statics*. But the Plan of the whole Design should be enlarged, by the Addition of a Set of new Titles; and many new Sets of Experiments, relating to, (1.) The Analysis of Plants. (2.) The Improvement of Timber. (3.) The Uses of Fruits for making Drinks, and Wines. (4.) The best Ways of treating Vegetables for Food, Physick, Clothing, Building, Shipping, &c. &c.

^k See *Jacob Thomassius de Sensu sexto; sive Titillatione Venerea.*

^l See *Mr. Boyle upon Effluvia.*

^m Is this Observation verified?

the Winter dulls them. To abstain or intermit the use of *Venery* in moist and well habited Bodies, breeds many Diseases; particularly dangerous Impostumations. The Reason is evident; there being a suppression of a principal Evacuation; especially of the Spirits: for which, there is scarce any Evacuation, but in *Venery*, and Exercise. Whence the Omission of either of them causes all the Diseases of Repletion ^m. See the *Article* TITILLATION.

VINEGAR.

Of Vinegar.

The turning of *Wine* to *Vinegar*, is a kind of *Putrefaction* ⁿ: and in making of Vinegar, they set Vessels of Wine to the noon Sun; which calls out the more oily Spirits, and leaves the Liquors sour and hard. So, burnt Wine is more hard and astringent than Wine unburnt. 'Tis said, that Cyder ripens in crossing the *Line*; when Wine or Beer turns sour. Set a Rundlet of Verjuice to the Sun in Summer, as they do Vinegar, to see whether it will ripen and sweeten ^o.

VISION.

Why Globes appear flat at a Distance.

1. All Globes appear flat afar off: for Distance, being a secondary Object of the Sight, is not otherwise perceived, than by more or less Light; which disparity, when it cannot be discern'd, all seems one: as it generally is in Objects not distinctly seen. So, Letters, if by reason of the Distance, they cannot be discern'd, shew but as a dusky Paper: whilst all Engravings and Embossings appear plain at some Distance ^p. See the *Article* SOUND. Sect. XX.

2. Both

^m The lighter part of this Subject has been considered, with great Curiosity, by certain Authors; but in its grave physical Part by few. A proper *History of the venereal Art* requires a sober and careful Writer; well versed in physical *Anatomy*, the *Natural History of Animals*, and *Physick*.

ⁿ It may be called a real *Putrefaction*; allowing that word to stand for a Change of one Body into another, of very different Properties; but let the common acceptation be guarded against; which denotes rather the *Corruption* and *Destruction* of a Thing, or its becoming unfit for certain Uses. This is not the *Philosophical Sense* of the Word. See *Boerhaave's Chemistry*, in the Chapter of *Fermentation*, *vinous* and *acetous*.

^o The *History of Vinegar* requires many curious Experiments, that might open a new Scene in *Natural Philosophy*. It would certainly point out an *uncommon Doctrine*, with regard to *Transmutations*. But I know not how, it seems in a manner to be overlook'd by the generality of *Philosophers*: tho it must be allow'd that *Glauber*, *Becher*, and *Stahl* have some original Experiments for disclosing its Nature. And *Boerhaave* in his *Chemistry*, has collected together many Particulars from other Authors, relating to it. But the Subject enfolds many *Mysteries*, that require a strict *Philosophical Search*; able to inform the *Vinegar-maker*; and teach him much *shorter* and more *profitable* ways of working. For Vinegar may be made from numerous cheap *Materials*, in a very small compass of Time; without depending upon the Sun; which is excessively tedious; and without the use of *Rape*, &c. And it is strange the *Chemists*, and those who prepare large quantities of *Saccharum Saturni*, which requires a large proportion of distill'd Vinegar, should not be acquainted with these *gainful Methods*. The *Chemists* may, if they please, prepare their *Vinegar*, for this purpose, from *Treacle* and *Water*; in a few days time. See the *Articles* MATURATION and SUGAR.

^p Consult the *Writers of Opticks* upon this Head; and Mr. *Berkley's Dialogues of Vision*.

2. Both Eyes move the same way : for when one Eye moves to the Nostril, the other moves from the Nostril. The Cause is Motion of Consent; which is strong in the Spirits, and spiritual Parts : yet Use will induce the contrary ; for some can squint when they will : and the common Tradition is, that if Children be set upon a Table with a Candle behind them, both Eyes will move outwards ; as affecting to see the Light ; and so cause squinting ¹.

3. We see more exquisitely with one Eye shut, than with both ² ; because the vital Spirits thus unite themselves the more, and become the stronger. For we may find by looking in a Glass, whilst we shut one Eye, that the Pupil of the other dilates.

4. If the visual Rays meet not in one Angle, the Eyes see double ; for seeing two Things, and seeing one Thing twice, works the same Effect : and therefore a little Pellet held between two Fingers laid a-cross, feels double.

5. Pore-blind Men see best in a dim Light ; have their Sight stronger near hand ; and can read and write smaller than those who are not pore-blind : Because the visual Spirits, in the pore-blind, are thinner and rarer than in others ; and therefore the greater Light disperses them. For the same reason they need contracting ; but being contracted, they are more strong than the visual Spirits of ordinary Eyes ; as when we see thro' a Level, the Sight is stronger : so it is when we gather the Eye-lids somewhat close : and 'tis common for those that are pore-blind to gather the Eye-lids. But old Men, when they would read, hold the Paper at some Distance ; for the visual Spirits of old Men unite not, but when the Object is at some distance from their Eyes ³.

6. When Men look towards the Sun, or a Candle, they see better by putting their Hand a little before the Eyes ; for the glaring of the Light, weakens the Eye : whereas the Light diffused abroad is sufficient for Vision ; too much Light making the Eyes dazzle ; and a perpetual looking against the Sun would cause Blindness. Again, upon coming out of a great Light into the Dark ; and coming out of the Dark into the Light, Men seem to have a Mist before their Eyes ; and see worse than after they have stayed a little while, either in the Light, or in the Dark : for the visual Spirits are, upon a sudden Change, disturbed and put out of order ; and till recollected, do not perform their Function well : when they are much dilated by Light, they

¹ There seems to be Truth in this common Observation ; insomuch that if Children are placed in the Cradle, where the Light comes sidewise, it is found to make them squint. And the Cure is effected by a proper Contrivance to make them look right before ; that the Rays of Light may strike the Pupilla perpendicularly.

² Do not Objects to some People, appear also considerably larger, when they use one Eye, than when they use both ? And what is the physical Reason thereof ?

³ Opticians now generally explain these Matters in a Mathematical manner ; making the visual Rays, or Rays of Light to be Lines ; the Humours of the Eye a kind of Glasses ; and the Retina, or Expansion of the Optic Nerve at the bottom of the Eye, the Seat or Canvas of a miniature Picture thus produced, resembling the original Object. But to discover the efficient Cause and Manner of Vision, requires a more physical Search.

they cannot contract suddenly ; and when much contracted by Darkneſs ; they cannot dilate ſuddenly. And exceſs both of Contraction and Dilatation, if long continued, deſtroys the Organ. For as long looking againſt the Sun, hurts the Eye by Dilatation ; ſo Miniature Painting, and the reading of ſmall Letters, hurt it by Contraction †.

*Why the Eyes
become red in
Anger.*

7. It has been obſerved, that in Anger the Eyes become red ; and in bluſhing, not the Eyes, but the Ears, and parts behind them. The *Cauſe* is, that in Anger, the Spirits aſcend and grow brisk ; which is eaſily ſeen in the Eyes, that are transparent ; tho' withal it makes both the Cheeks and Throat red : and in bluſhing, the Spirits aſcend to ſuccour both the Eyes and the Face, which are the parts that labour : but then they are repulſed by the Eyes, becauſe the Eyes in ſhame put back the Spirits that aſcend to them ; as unwilling to look abroad : for all Men in that Paſſion appear dejectedly ; and this repulſe from the Eyes, diverts the Spirits and Heat more to the Ears, and parts adjacent †.

*Why the ſight
has no diſa-
greeable Object.*

8. The Objects of Sight, tho' they may cauſe a great Pleaſure, yet give no Pain, or great Offence, unleſs by Memory. The play of Diamonds that ſtrike the Eye ; *Indian* Feathers of curious Colours ; the coming into a fine Garden, or Room richly furniſh'd ; a beautiful Perſon, &c. greatly delight and exhilarate the Spirits. The Reaſon why the Effect holds not in giving Offence, is, that the Sight, being the moſt ſpiritual of the Senſes, has no Object groſs enough to offend it. But the principal *Cauſe* is, that there are no active Objects to offend the Eyes. Harmonical Sounds, and Diſcords, are both active and poſitive ; ſo are good and bad Odours ; bitter and ſweet Taſtes ; too great Heat and Cold to the Touch ; but Blackneſs and Darkneſs are Privatives ; and therefore have little or no activity. However, they do ſomewhat ſadden the Mind ; tho' very little. See the *Article* SENSES.

*How Objects
appear by Re-
fraction.*

9. Light by Refraction ſhews Objects larger, as well as colour'd : for as a Shilling at the bottom of Water appears larger, ſo will a Candle in a Lanthorn under Water. I have heard that Glow-worms, included in Glaſſes, are put into Water to make the Fiſh come together : but whether a Diver having his Eyes open, and ſwimming upon his Back, ſees Things in the Air, greater or leſs, I am not certain. 'Tis manifeſt, when the Eye is in the finer Medium, and the Object in the groſſer, Things appear larger ; but when the Eye is in the groſſer Medium, and the Object in the finer, the Experiment remains to be tried †.

*Refractions to
be tried after
Reflections.*

10. It ſhould be well examin'd whether great Refractions may not be made upon Reflections ; as well as upon direct Rays. For Example, if you put a Shilling into an empty Baſon, then go ſo far from the Baſon, that you cannot ſee the Shilling ; if the Baſon be now fill'd with Water, you will

† But the Eye is found to dilate and gradually accommodate itſelf to a ſmall degree of Light, or what is commonly called Darkneſs ; whence Men have been able to ſee ſmall Objects in dark Dungeons.

‡ See the *Article* PASSIONS.

§ See Sir *Iſaac Newton's Opticks*, paſſim.

will see the Shilling out of its place. Therefore, put a Looking-glass into a Basin of Water; and I suppose you will not see the Image in a right Line, or at equal Angles, but on one side. Perhaps this Experiment might be so extended, that one should see the Image, and not the Glass; which would seem strange: for then the Image would appear like a Phantom in the Air. For Example, place some strange Picture over a Cistern of Water; so that you may not see the Water: then put a Looking-glass into the Water; and now if you can see the Picture aside, without seeing the Water; it would appear very surprizing. They have an old Tale in *Oxford*, that Friar *Bacon* walk'd between two Steeples: which was thought to be done by Glasses; whilst he walked upon the Ground *.

U L C E R S.

'Tis noted by the Ancients, that in gross or impure Bodies, Ulcers in the Legs are hard to cure; but in the Head more easy: for Ulcers in the Legs require Desiccation, which the defluxion of Humours to the lower Parts hinders; whereas Ulcers in the Head require it not. And in modern Observation, the like Difference has been found between *Frenchmen* and *Englishmen*; the Constitution of the one being more dry, and of the other more moist: whence, a Wound in the Head of a *Frenchman*, but in the Leg of an *Englishman* is harder to cure *. See the Articles SWELLINGS and WOUNDS.

W.

W A T E R.

Water looks blacker when moved, and whiter when at rest. Because, by reason of the Motion, the Rays of Light pass not direct; as they do when the Water is at rest. Besides, Splendor has a degree of whiteness; especially if there be a little Repercussion: for a Looking-glass with the Foil behind, looks larger than a bare Glass †. This Experiment deserves to be carried farther, in discovering by what means Motion may hinder Sight ‡.

2. 'Tis a Thing of great Use to discover the goodness of Waters. The Taste, to such as drink Water only, may do somewhat: but other Experiments

*The Cure in
some Ulcers.*

*Why Water
looks black
when moved.*

*Trials to dis-
cover the good-
ness of Water.*

* There are many Curiosities of this kind practicable, from a commanding Knowledge in Opticks, and the Properties of Glasses, variously figured, disposed and combined. See the Writers upon Opticks, Dioptricks and Catoptricks; and consider of the proper Combinations for the purpose.

† The Enquiry how far the Effects of Climate and Constitution reach in accelerating or retarding the Cures of Diseases, seems not duly prosecuted. Perhaps the Remedies proper for a Disease in one Country, may sometimes prove pernicious in another; as seems to be the Case of *Lime-water*, used in *England* and *France*. See *Memoir. de l' Acad. An. 1700.*

‡ Do not all Bodies that reflect Light strongly, look larger than those that reflect it weakly? And is not this owing to the diffusive, or spreading Nature of Light, throwing itself out every way?

‡ As by great Velocity, Unsteadiness, &c.

riments are more sure. (1.) Try Waters by weight ; wherein you may find some difference ; and account the lighter the better. (2.) Try them by boiling upon an equal Fire : and that which consumes fastest account the best. (3.) Try them in several open Vessels of equal size ; to see which lasts longest, without Stench or Corruption : And that which keeps longest unputrefied, account the best. (4.) Try them by making Drinks stronger or smaller, with the same quantity of Malt ; and conclude that the Water which makes the stronger Drink, is more concocted and nourishing ; tho perhaps it be not so good for medicinal Use. And such commonly is the Water of large navigable Rivers ; and large and clean stagnant Ponds : upon both which the Sun has more power, than upon Fountains or small Rivers. And I conceive that Chalk-Water is next to these the best, for going far in Drink : as this also helps Concoction ; if drawn out of a deep Well ; which thus cures the rawness of the Water : but chalky Water, towards the top of the Earth, is too fretting ; as appears in the Laundry : for Linens wash'd with such Waters, wear out apace. (5.) The good House-wives find a difference in Waters for bearing or not bearing of Soap : and 'tis likely that the fat Water will bear Soap best ; for hungry Water kills the unctuous Nature of the Soap. (6.) Judgment may be made of Waters according to the place from whence they spring or come : Rain-water is by Physicians esteemed the finest and best ; yet it is said to putrefy soonest ^a : which is likely, because of the fineness of the Spirit : and in Conservatories of Rain-water, 'tis not found excellent ; the worse perhaps, because they are cover'd above, and kept from the Sun. Snow-water is held unwholesome ; inasmuch that the Inhabitants at the foot of Snow-Mountains, by drinking of Snow-water, have great Bags under their Throats. Well-water, except it be upon Chalk, or a very plentiful Spring, makes Meat red ; which is an ill sign. Springs on the tops of high Hills are the best : because they seem to have a Lightness ; and are more pure and unmixed, and better percolated thro' a great space of Earth. For Waters of Valleys, in effect, join under Ground, with all Waters of the same Level ; whereas Springs on the tops of Hills, pass thro' a deal of pure Earth, with less mixture of other Waters. (7.) Judgment may be made of Waters by the Soil, whereon they run ; as that upon Pebble is the cleanest and best tasted ; next, that upon Clay ; thirdly, that upon Chalk ; Fourthly, that upon Sand ; and the worst of all is that upon Mud. Nor should we trust to Waters that taste sweet ; for they are commonly found in rising Grounds of great Cities, and must needs receive much Filth ^b.

*How Water
operates upon
contiguous Air.*

3. Water being contiguous to Air, cools, but does not moisten it ; except the Water evaporates ; for *Heat and Cold have a virtual Transfition, without Communication of Substance ; but Moisture* not : and all Madefaction requires an Imbibition

^a Is that Rain Water apt to corrupt, which has by standing deposited its Sediment, not in a Wooden, but a clean Glass or Stone Vessel ; and been drawn off pure into another Vessel of the same kind ?

^b This Subject of Water has been in some measure prosecuted by Mr. Boyle ; and since by Dr. Hoffman in a great variety of judicious Experiments. See his *New Experiments and Observations upon Mineral Waters* ; and Dr. Boerhaave's Chapter of Water, in his *Chemistry*,

Imbibition. But where the Bodies are of such different Gravities as not to mix; there can follow no Imbibition. Whence Oil lyes on the top of the Water, without commixture: and a drop of Water running swiftly over a Straw or other smooth Body, does not wet it^c. See the *Article* AIR.

WEATHER.

'Tis an Observation among Country People, that plentiful Years of Haws commonly portend cold Winters. They ascribe it to Providence, that reaches even to the falling of a Sparrow; and much more to the preservation of Birds in such Seasons. The *Natural Cause* may be the want of Heat, and abundance of Moisture, in the preceding Summer, which puts forth these Fruits, and must needs leave a great quantity of cold Vapours undissipated; and thus produces the Cold of the following Winter^d. See the *Article* DIVINATION.

WINDS.

Mens Bodies are heavier, and less disposed to Motion, when Southern Winds blow, than when Northern: for when the Southern Winds blow, the Humours, in a manner, melt, grow fluid, and so flow into the Parts; as we see in Wood, and other Bodies; which swell with a South Wind. Besides, the Motion and Activity of the Body consist chiefly in the Nerves and Sinews; which relax with a Southern Wind^e.

WINE.

1. 'Tis said they have a way of preparing their Greek Wines, so as to keep them from fuming and inebriating, by adding Sulphur, or Alum; whereof the one is unctuous, and the other astringent. And indeed those two Natures best repress Fumes. This Experiment should be transfer'd to other Wine, and strong Beer, by putting the like Substances to the fermenting Liquor; which may make them both fume and inflame the less^f.

2. The use of Wine is hurtful in dry and emaciated Bodies; but in moist and full Habits beneficial. For the Spirits of the Wine prey upon the radical Moisture, as they term it, of the Body; and so defraud the animal Spirits. But where there is Moisture sufficient or superfluous, Wine helps to digest, and dry it up^g.

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R r

WOUNDS.

^c Is this Effect wholly owing to a difference in the Gravity of the Bodies? See Boerhaave's *Chapter of Menstruums*.

^d See the *Author's History of Winds*.

^e See the *Author's History of Life and Death*, and *History of Winds*.

^f Does the way of correcting the Greek Wines here mentioned, turn upon the use of Sulphur, or Alum in Substance; or in Fume, or acid Spirit? The use of burning Brimstone in the way of *Match*, as the Wine-Coopers call it, is common, and of very extraordinary Efficacy; tho' overlook'd by Philosophers. And the beneficial use of the acid Spirit of Sulphur, or Alum, is a secret in Wines, that lies in few Hands. The *Natural*, and *Experimental History of Wines* is greatly wanted; as well for the improvement of Philosophy, as the Service of ordinary Life. See the *Article* SUGAR.

^g There is wanting a solid Account of the Virtues and Uses of Wines; to be drawn from Experience and Observation; without indulging Levities, or running out into *Encomium ex Inveniente*.

WOUNDS.

Wounds to be treated with Brasi Instruments.

1. 'Tis noted, by the Ancients, that Wounds made with Brasi, heal easier than those made with Iron : for Brasi has a healing Virtue ; whereas Iron is corrosive. It were therefore proper, to have chirurgical Instruments made of Brasi, rather than Iron ^b.

Wounds how best healed.

2. 'Tis observed that a Sheep-skin newly pulled off, or Whites of Eggs applied to Wounds, will keep them from swelling or exulcerating ; and heal them. The *Cause* is a temperate Conglutination ; for both these Bodies are viscous, and restrain the Flux of Humours to the Part, without penning them in ^c. See the *Articles* SWELLINGS, and ULCERS.

Y A W N I N G.

Dangerous to pick the Ear in yawning.

IT has been noted dangerous, to pick the Ear whilst one yawns : for in Yawning, the inner part of the Ear is extended, by drawing in the Breath ; as both in Yawning and Sighing, the Breath is first strongly drawn in, and then strongly expelled ^d.

I N S T A U -

^b Is the ancient Observation just, upon which this Direction is founded ? For the medicinal Virtues of the several Metals, see *Boerhaave's Chemistry*, under the Processes upon Metals.

^c The Method of curing Wounds by the first Intention, has not been diligently prosecuted, but rather meets with Opposition.

^d Let a nearer Approximation be made to the *Cause* ; if the *Fact* be sufficiently verified.

End of the SYLVA SYLVARUM.

INSTAURATION.

PART IV.

SCALA INTELLECTUS:

OR, THE

Progreſs of the Underſtanding

I N

PHILOSOPHICAL ENQUIRIES:

SHEWING, BY

EXAMPLES,

The METHOD of Employing the

Materials of the SYLVA SYLVARUM;

And Illustrating the

Rules and Directions of the *NOVUM ORGANUM*,

For Building a

SOUND PHILOSOPHY,

By the MEANS of

PARTICULAR HISTORIES.

SCALA WATTELLA

1807

Progress of the Understanding

IN

PHILOSOPHICAL ENQUIRIES

SHEWING

EXAMPLES

OF THE

METHODS OF THE SCIENCE

OF

PHILOSOPHY

AND

PHILOSOPHY

OF

PHILOSOPHY

P R E F A C E.

THE Author appears to have published nothing with a direct and immediate View to the fourth Part of his *INSTAURATION*. The Design of that Part was to contain a competent Set of Examples, or Models, for working with the Mind, in philosophical Subjects, according to the genuine Laws of Induction; intimated, and, in some measure, explained, in the *Novum Organum*. We are, therefore, to understand the following Pieces of Life and Death, &c. not as Examples of a genuine Induction; but as mixed Writings, which deliver Matter of Natural History, in a Method approaching to that of Induction; but frequently interrupted by large Observations, Admonitions, and Directions. Indeed it should seem, that the Author designed to have digested and improved all the Matters collected in his *Sylva Sylvarum*, after the manner of these Examples; in order to facilitate the Business of strict Induction, that was to follow in the intended fourth Part of the *INSTAURATION*; the perfecting whereof belonged to the sixth. In the room, therefore, of the intended Set of more rigorous inductive Histories, are here substituted a somewhat looser kind; of the same general Nature, Method, and Tendency. And perhaps the Author might find, that the imperfect State of Philosophy in his Time, could scarce, to advantage, allow of a more rigorous Induction, without launching into mathematical or metaphysical Considerations; which would have been deviating from his Purpose. At least, he seems to have chose, if not the most strict, yet the most instructive Method of Inductive History; whereby the succeeding Philosophers might be directed how to conduct and prosecute Enquiries in the more perfect manner; and gradually proceed to Axioms, and capital Rules of Practice.

INTRO-

INTRODUCTION^a.

1. **T**HEY who have not acquiesced in the Doctrines and Positions of the Ancients, whether from a Firmness of Mind, as is sometimes the Case; or from a Levity of Temper, which more frequently happens; generally defend their procedure with this Argument; that tho they relinquish Antiquity, yet they produce such Things of their own as are perfectly agreeable to Sense: and that if other Men were not awed by Authority, and durst trust to themselves, they would easily come over to this side. But for our own part, we neither offer Violence to the Senses by Contradiction, nor destroy them by Abstraction; but have supplied them with a much larger Fund of Matter than others. We wou'd correct their Errors by various Administrations, enlarge their Powers, improve their Judgment, condemn their Illusions, and by bringing Reason into a due Frame, confirm, strengthen, and guard them; thus endeavouring to perform what others only profess; and really defend, confirm and improve the Senses: the Tendency of our whole Philosophy being little more than to free and restore them ^b.

The Author's View to free and restore the Senses.

2. Yet we promise ourselves no great Influence upon the Belief of Men; because our Method agrees with none of those that have gone before us; but proceeds quite contrary thereto. For they who before us, being sick of the Doctrine of the Ancients, applied to Sense and Experience, as to a thing almost entirely new; have, generally, at first made some Enquiries with Vigour and Resolution, under the Conduct of the Senses; and seized upon those Things which seem'd to them of a more general Nature: and from such detach'd Parcels of Experiments they immediately proceeded to form Theories; and thus philosophized by starts, with narrow Views; and judged of all Things by a few.

Yet expects no great Credit.

3. This imperfect Method of philosophizing is, however, often successful, in gaining Credit, from the narrowness of the Mind, which is principally moved by such Things as strike and enter it at once; and being desirous of acquiescing in some one Thing, either neglects all the rest; or else, in a certain imperceptible manner, supposes that all Things else are correspondent to those few which naturally fill and distend the Imagination.

Which the imperfect Method of philosophizing has gain'd.

V O L. III.

S f

4. We,

^a The following *Introduction* to the fourth Part of the *INSTAURATION*, is collected from certain scatter'd Fragments in the *Scripta*, published by *Gruter*.

^b See the *Novum Organum*, Part II.

*The Method
chose by the
Author.*

4. We, on the contrary, who desire to introduce not handfuls of Experiments, or little detached Systems of Things ; but the whole Universe with its Works, as formed by the great Creator ; and aim to pronounce according to the Truth and Result of Things ; scarce know which way to turn ourselves, or on what side to solicit our entrance into the Mind, and gain a Credit to what we are about. For the Things we have to offer go deeper than Notions ; and spread wider than partial Experiments. Whence it must necessarily happen, that the greatest part of what we deliver will not satisfy the over-hasty and quick Apprehensions of Sense ; to which some of our Doctrines will appear hard and incredible, almost like Points of Religion. For the Senses certainly deceive us ; tho' not when duly rectified and assisted. We therefore enter upon a new way of delivering ourselves, agreeable to the Work we have in hand ; and proceed, not by disputing, or by producing a few scattered Experiments ; both which ways might frustrate our End, as our Determinations are neither founded upon Notions, nor upon main'd and divided Experience : but we use Experiments collectively ; lead the Mind, in a continued Chain, to the Fountain of Things ; and set to view the whole process of the Understanding, with the Advantages and Uses to be derived therefrom. Those therefore, who either rest upon Arguments, or depend upon a few Experiments, or, thro' a narrowness of Mind, submit to Authorities, or for want of opportunity, cannot give our Works their due perusal, and must not expect to comprehend our meaning.

*The Opinion
that nothing is
knowable con-
sider'd.*

5. It would be a difficult Task to confute those who will have nothing to be knowable ; even tho' we candidly interpret the Expression. For if any one should maintain that true Knowledge is the Knowledge of Causes ; and that the Knowledge of Causes is continually rising and climbing, in a certain Series, to Things the best known in Nature ; so that a Knowledge of Particulars cannot be properly had without an exact Comprehension of universal Nature ; it is not easy, on the footing of sound Judgment, to maintain the contrary. For it seems improbable, that any true Knowledge can be had, till the Mind is perfectly versed in the Explanation of Causes : and to attribute a complete Knowledge of the Universe to the human Mind, might seem rash and injudicious.

*The Disad-
vantage of
that Opinion.*

6. On the other hand, the Patrons of this Opinion, without explaining themselves in this way, have ventured to profane the Oracles of the Senses ; which is bringing Things to the utmost Despair. But to say the Truth, tho' they had not thus calumniated the Senses, yet the Dispute might seem to be contentious, and unseasonable ; since without that precise Truth they seem to mean, there is such a wide Field left open to human Industry, as makes it preposterous, and almost Madness to be solicitous about securing the extremities of Things ; and at the same time overlooking, and disregarding Things of such infinite Use as lie in the middle. For how much soever they wou'd seem to destroy the Certainty, and yet retain the Use of Knowledge, by their Distinction betwixt Truth and Probability ; and with regard to the active Part, leave a free Choice of Things ; yet by taking away the Hopes of discovering Truth, they have doubtless cut the Sinews of Enquiry ; and

and by a confused licentiousness in their own Searches, turned the Business of Invention and Discovery into Disputes, and the Exercise of the Wit.

7. We cannot however deny, that if we have any Fellowship with the Ancients, 'tis principally in this their kind of Philosophy; as we approve many of the Things they have prudently observed, and delivered, upon the Deceptions of the Senses, the Weakness of the Judgment, and the withholding of the Assent. And to these we might add many other Particulars, of the same Tendency: so that the difference betwixt them and us only lies here, that they will have nothing to be justly knowable in any way; and we not in the way which Men have hitherto gone. And if we admit into our Society, not only such of the Ancients as hold this Opinion in Theory, and Speculation, but such also as manifest the same in Questions and Objections, either by loudly complaining of the obscurity of Things, or secretly revolving it in their Minds, and only now and then whispering it out; there will be found the greatest Men of Antiquity in the Number: Heroes in Contemplation, and such whose Company any one might wish to be found in. For tho perhaps one or two of the Ancients have shewn a Confidence, and a Positiveness in pronouncing; yet this has been no prevailing practice till of late, in barbarous Ages; and is only still retain'd thro' Faction, or Party Negligence and Custom.

The Author's agreement with the Ancients.

8. But as to the Society we thus join in, every one will easily perceive that we only concur with them in the setting out; and differ widely from them in the End: for altho there may at first seem no great Difference between us, as they simply assert the insufficiency of the human Understanding; and we only in a certain respect; yet at last they, neither discovering, nor hoping to discover, any Remedy of the Misfortune, forsake the Business, and falling foul on the Certainty of the Senses, subvert the firmest Foundations of Science: whilst we, by introducing a new Method, endeavour to rectify and repair the Errors, both of the Senses and the Mind itself. So that whilst they, looking upon the Thing as past Recovery, give themselves up to a certain Licentiousness, and wandering of Thought; we, from our Preconception, have undertaken a more remote and difficult Task, which we ardently wish may redound to the Felicity of Mankind.

His difference from them

9. The Entrance of the Road we pursue is described in the *second Part* of our *INSTAURATION*, or *Novum Organum*; and follow'd in the *third Part*, the *Phænomena of the Universe*, in our *Sylva Sylvarum*; where we endeavour'd to penetrate, and pass thro' the *Woods of Nature*, thick set and darken'd with a great variety of Experiments, as with Leaves; and entangled and twined together, like Shrubs and Bushes, with the subtilty of Observations. We are

Transition to the Design of the Scala Intellectus.

S I 2

now

* Hence appears another Reason why the Author's *History of Nature* was entituled *Sylva Sylvarum*; besides that of the simple meaning of those words, denoting only a *Repository* or *Magazine* of Materials, of all sorts: for the figurative Sense is, as here explained, a thick Wood of Experiments and Observations; and with relation thereto, the *fourth Part* of the *INSTAURATION* is sometimes called *Filum Libyrmithi*; as being the *Clue* of the *Sylva Sylvarum*.

now perhaps proceeding to the more open Parts of Nature ; which however are still more difficult ; and having got thro' the Woods, are come to the bottoms of the Mountains : for tho the way was never attempted before, we shall lead on from *particular Histories to Universals*, in one certain and continued Path.

*The two ways
of the An-
cients.*

10. And here we cannot but observe, that those two famous Ways of the Ancients in active Life, have a great Correspondence with the ways of Contemplation ; the one whereof being at the first plain and easy, leads on to cragged, dangerous, and impassable Places ; but the other beginning steep and difficult, ends in a Plain : for in the same manner, he who at the first Enquiry into Nature, lays hold of certain immovable Principles in the Sciences, and trusting to them, shall hope to find out every thing else, as it were at Leisure ; if he proceeds in his Enquiries, without being over satisfied or dissatisfied by the way, will find himself got into the first of these Roads. But he that shall be able to withhold his Judgment, ascend by degrees, and pass as it were over the tops of Mountains, climbing first up one, then up another, and so to a third, with true Patience and unwearied Diligence ; will in due time arrive at the Heights and top Rounds of Nature, where there is a sure Footing, a serene Station, and a beautiful prospect of Things ; with a gentle and easy Descent, leading down to all practical Arts ^d.

*The Scheme of
the Scala In-
tellectus.*

11. Our Design therefore is this ; that as in the *second Part* of our INSTAURATION, we have laid down Precepts for a just and legitimate Enquiry into Nature ; so in this *fourth Part* we wou'd give *Examples* of such an Enquiry, in a variety of Subjects ; in such a *Manner* as we judge to have the exactest Correspondence with Truth : and therefore deliver as a *Manner* chosen and approved.

*The Method of
Enquiry is
pursued.*

12. We do not however, after the common Custom of Men, propose our own Forms and Methods of Enquiry, as if they were inviolable, the only ones, and perfect in all their Parts ; so as to make it absolutely necessary to use them : for we would by no means cramp or confine the Industry and Felicity of Mankind. There is no doubt but Men of Genius and Leisure, either of themselves, or as being now freed from the Difficulties which necessarily attend the first breaking of the Ice of Experience, may carry our *Method* to greater Perfection ^e : and 'tis our earnest Desire, that the true Art of conducting Enquiries should improve ; as it certainly will, since all Arts must improve with new Discoveries. Only this we must say, that after trying all the ways we could think of, and having had long Experience of our present Method of conducting Enquiries, we have found none equal to it, for the commodiousness it affords in working with the Understanding.

13. If

^d Hence we see the Reason why this *fourth Part* of the INSTAURATION is sometimes called *Scala Intellectus*, or the Steps of the Understanding ; by which it ascends to the Regions of Truth ; or, without a Figure, to the general Axioms of sound Philosophy ; that at once contain both the Theory and Practice of all Arts and Sciences. And this Philosophy was to have been the sixth and last Part of the INSTAURATION.

^e The Author's *Motto* is MONITI MELIORA. See Dr. Hook's Method of improving Philosophy ; and M. Tschirnhaus's *Medicina Mentis*.

13. If we are accused of going into a *new Way* of acquiring and delivering Knowledge, and dropping the Method of Procedure by Doctrine and Precept, as if we over-looked it; and principally prosecute the Business by Examples; we answer, that we think there is the utmost Reason for this Procedure. And we would not have Mankind ignorant of the Course we take; for 'tis their Business, not our own, that is now before us: and we judge their common Fortune is concerned in the Execution.

Is a new Method.

14. And first; we seem by this Method to secure one principal Point, which is that of being clearly understood: for 'tis one thing to subjoin Examples to particular Precepts, respectively; but a very different one, to construct and exhibit a perfect, and, as it were, solid Figure and Model of the whole Work. Thus, for instance, several Problems in Mathematicks and Astronomy may, by the Assistance of Globes and proper Machines, be clearly and easily solved; and would, without such Contrivances and Assistances, appear much more difficult and perplexed than they really are. And here it usually happens, that the larger the Instrument is; the clearer and more satisfactory the Demonstration proves.

Its Advantages; viz. rendering Things intelligible.

15. We also hope to find a considerable Advantage from this simple and gentle Procedure; which neither offers Violence, nor lays Snare for the Judgment; but barely, and nakedly, exhibits the Thing. No Writer before us has led Mankind to the Fountains of Nature, and Things themselves, for a common Good; but all of them have applied Examples and Experience to confirm or illustrate their own Dictates and Doctrine, without leaving others the liberty of judging for themselves: in so much that we hope to have deserved well of Mankind, in two things which they hold dear; for we leave them at once in possession both of *Power* and *Liberty*: *Power*, with regard to Works; and *Liberty*, in point of Judgment.

Leaving the Reader possessed both of Power and Liberty.

16. And as, in Courts of Justice, that Procedure is ever the best, where least room is given to the licentiousness of the Pleader, tho' ever so eloquent; but all the time and pains are bestowed in examining the Witnesses: so, in the Courts of Nature, the Judgments of Men are then best employed, when the least Liberty is allowed to Contention, Dispute, and plausible Discourse; but the Mind wholly employed upon examining the Evidence, and collective Testimonies of Experience: for, in the Testimonies of Authors there is Heat, and Licentiousness; but the Answers and Testimonies of Things themselves, tho' they may indeed be sometimes obscure and perplexed, yet they are always sincere and uncorrupt.

To imitate the Procedure in Courts of Justice.

17. Again, we seem by this means to keep clear of a great Inconvenience, that might arise from the Pride and Prejudice of Mankind: for prudent, grave, and wary Men, suspect every new thing of Levity and Vanity, and condemn new Sects and new Opinions, as Masks and Mummies; judging it of little Significance, whether Men agree in their Theories

Suited to gain the Consent of the Prudent.

OR

or not ; only that the old ones, and such as are more current and received, are best fitted for Business, and conducting the Affairs of the World, on account of general Consent, and moral Considerations. Now there is no Remedy for this Inconvenience, but by the copiousness of the Example to strike so far into the Senses of Mankind, that any one of a tolerable Judgment, shall, at first sight, perceive the thing to be sober and solid, and pregnant with Usefulness, and Works ; and immediately acknowledge it of a quite different Nature and Tendency from that of raising of a new School, or a new Sect.

*Preserve a due
Respect for the
Ancients.*

18. By this Means likewise, we are not without hopes to abolish, in some degree, that Authority and Confidence which Men have placed in the Ancients, and others ; who introduce their own Opinions and Notions into Philosophy ; at the same time that we preserve the Respect and Reverence due to them : and this not by any Artifice, but from the simple Force of the thing itself.

*Shewing what
Course the
Ancients took
in their En-
quiries.*

19. We farther conceive, our Method may lead Men to reflect, whether the Ancients have, themselves, made use of this kind of Diligence ; and built their Doctrines and Opinions on sure Foundations. And indeed this might, to some, appear a Point of Debate ; if only the Opinions of the Ancients had been handed down to us, without the least Intimation of their Method of Enquiry and Demonstration : for then we might be apt to suspect, that from the very first of their Contemplations, they had procured a large Stock of Examples ; and disposed them in a similar, or perhaps a better order, than ourselves ; and that they pronounced after a thorough Examination of the Matter ; and at length set down their Determinations, with their Explanations and Corrections, in Writing ; only adding here and there an Example or two, for the sake of Instruction ; but judged it unnecessary and tedious, to publish their first Notes, rude Draughts, Hints, Journals, and Common-place-books : thus imitating Builders, who, after they have raised their Pile, take away the Scaffolding. But themselves will not suffer us to think thus of them ; for they openly declare the Form and Manner they used in their Enquiries : and their Writings give us a clear and express Image of it. Their Method was, from certain Examples, most familiar to the Senses, to rise at once to the most general Conclusions, or Principles of the Sciences ; and according to the fixed Truth hereof, to derive inferior Conclusions by Intermediates. And having once established this Art ; if any Controversy afterwards arose, about an Example that seem'd to contradict their Principles, they rendered it conformable to them by Distinctions, or the application of their own Rules. Or if any mention was made of the Causes of particular Things ; they ingeniously accommodated them to their own Speculations. And hence we have a distinct View both of the Thing itself, and the Error of their whole Procedure : for they plainly dismissed Experience too soon ; and either neglected the intermediate Conclusions, which are the animating Souls of Works ; or rested them upon a weak Foundation : and, what is not represented, substituted an

an illegitimate and unprosperous Subtilty of Wit, for Sense itself. And if at any time there is mention made in their Writings, of Examples and Particulars, these come too late ; and after they had past Sentence, and fixed their Positions. But our Method is directly opposite to this ; as will be abundantly manifest from the *Tables* themselves.

20. This therefore being the Case, we shall still leave the Ancients unrival'd, and in full Possession of all that Praise and Admiration which any one shall think their Due. And some of them were, doubtless, Men of an excellent Genius ; which our Method has little Occasion for : since it puts the Capacities and Powers of Mankind nearly upon a Level. Thus, if a long, set Speech were to be delivered by Memory ; a Man of a good Memory would have a great Advantage over another of a bad one ; but if they were both to read their Speeches, the Difference in that case would be none at all. And thus it is in the Contemplation of things, which depends entirely upon the Powers of the Mind ; where one Man infinitely excels another. But where the Enquiry is carried on by *Tables*, and a due Use and Application thereof ; there is not much more Difference than we usually find in the Senses of Men. And indeed, we are afraid of a too great Subtilty and Agility of Genius in our Method ; whilst Men are carried away with their own impetuous Motions : and would therefore add, not Wings, but Weights to their Capacities.

Setting all Men upon a level.

21. Nay, by Means of our *Tables*, we question not but to secure the most difficult Point of all ; and bring it about, as it were, spontaneously, that after Mankind, (tho at the first Entrance it may seem somewhat difficult and strange) shall be a little accustomed to the natural Subtilty of Things exposed to their View ; and become familiar with their Differences, plainly marked out in Experience, they shall soon look upon that Subtilty of Words and Disputes, which has hitherto employed and detained their Thoughts, but as a ludicrous thing, a kind of Charm, Infatuation, or Spectre ; and pronounce of Nature, what is usually said of *Fortune*, that she has a Lock before, but none behind : as all that late and preposterous Subtilty of Dispute, coming after the time of Things is past, only catches at, but never lays hold of Nature.

And making them follow Experience.

22. We also judge ourselves here, to use a true, lively, and animated Form of Instruction : for we do not pluck the Sciences, like Flowers, from the Stalk ; but deliver them over, Roots and all, that they may be transplanted, or new set, in better Genius's, as in a more fruitful Soil ; that will bring them to greater Perfection. And for the Errors, Over-sights, Imperfections, and abrupt Breakings-off of our Enquiries, we, in our Method have this Advantage, that our Errors may easily be observed, and rejected, before they can deeply infect the Mass of Knowledge ; that our Imperfections, and Defects may be readily supplied and corrected ; and the Enquiries left unfinished, be continued under a successive Course of Additions and Improvements : and it is then that Men will know their own Strength, when infinite Numbers shall not do the same things over and over again.

To the perfecting of Enquiries.

again ; but some supply and finish, what others begun and left imperfect.

*Giving Far-
nest of Works.*

23. We have also hopes, by this Method, to prevent the Retortings whereto our frequent mention of *Works* might have exposed us, if we had not pressed Mankind to converse with Things themselves : for Men cannot now well require those Works from us, which we require from them ; whilst any one may easily perceive, that we do not barely talk about Works, because the Tables themselves contain some Draughts, Designs, and Earnests of new Works ; and, at the same time, plainly shew that our Scope is not, in the empirical manner, to derive Works from Works ; but, like Interpreters of Nature, *Causes* from *Works* ; and again, new *Works* from those *Causes*. Thus avoiding an unseasonable and hasty turning aside to Works, at the beginning ; but observing, and waiting, the due and appointed time of the Harvest.

*And a Notion
of the Extent
of the whole
Instauration.*

24. In the last place, we hope also by this Means to possess Mankind of a just Opinion, not only of the Efficacy and Intention of our INSTAURATION ; but also of the Bulk and Magnitude thereof : and thus prevent them from imagining that the Work we labour with, is an immense thing, beyond the Power of Mortals to effect ; whereas it generally happens that the most useful Things are the least voluminous. And tho the Enquiry into Nature we have here begun, may be too much for a few ; it might prove a facile Work for a SOCIETY OF MEN. And with a View to shew this still more clear and practicable, we shall here subjoin a *Catalogue of general Tables*, that may, perhaps, include the Whole.

A Catalogue of GENERAL TABLES ; for Enquiring into all the WORKS of NATURE.

1. **T**ables for the Enquiry of Motion.
2. Tables for the Enquiry of Heat and Cold.
3. Tables for enquiring into the Operations, Impressions, and Influence of Things at a distance.
4. Tables for enquiring into Vegetation, and Life of all kinds.
5. Tables for enquiring into the Actions and Passions of the Animal Body.
6. Tables for enquiring into the Senses, and their Objects.
7. Tables for enquiring into the Affections of the Mind.
8. Tables for enquiring into the Mind and its Faculties.

And these Tables regard the Separation, or Divison of Nature, in point of Form ; but the following regard the Construction of Nature in point of Matter.

9. Tables of Enquiry into the Structure, or Architecture of the Universe.

10. Tables

10. Tables for enquiring into the great Relations, or Accidents, of Existence.

11. Tables for enquiring into the Consistences of Bodies, or their Inequality of Parts.

12. Tables for enquiring into *Species*, or the Fabrication, and common Associations of Things.

13. Tables for enquiring into the lesser *Relations*, or *Properties*, of Bodies².

And thus the *Universal Enquiry* may be comprehended in thirteen *General Tables*, with their Dependents or *lesser Tables*; which are to be made occasionally, or as immediate Use shall require: for we in no case proceed without our *Tables*, or *Papers*. As a Specimen, we will here annex that *Set of Tables*, required by our *Method* in the Case of *Motion*; which is a copious and diffusive Subject.

A TABLE for a Legitimate Enquiry into MOTION.

1. The inferior Machine of the Understanding, or a Sequence of Tables upon the first View.

2. *Collective Tables*, exhibiting a Digest, or regular Series of History to the first Article; to shew the Terms and Differences of Motion.

3. A Table of Motion by external Application; or *Motion of Adherence*.

4. A Table of Motion by internal Application; or the Motion of Mixture.

5. A Table of the Motion of Application to Fibres; or the Motion of Identity.

6. A Table of the Motion of Assimilation.

7. A Table of the Motion of Impression; or Signature.

8. A Table of the Motion of Excitation.

9. Collective Tables of digested History, to the second Article.

10. A Table of the Subjects of Motion.

11. Collective Tables of regular History to the third Article.

12. A Table of the Vehicles; or Conveyancers of Motion.

13. Collective Tables of regular History to the fourth Article.

14. A Table of the Operations and Consequences of Motion.

15. Collective Tables of regular History to the fifth Article.

16. A Table of the Stages of Motion.

17. Collective Tables of regular History to the sixth Article.

18. A Table of the Sphere of Activity of Motion.

19. Collective Tables of regular History to the seventh Article.

20. A Table of the Government and Regulation of Motion.

21. A Table of regular History to the eighth Article.

22. A Table of the Associations of Motions.

V O L. III.

T t

23. Col-

² What Additions, or Improvements, might be made to this *Catalogue*, for promoting the general Design thereof?

23. Collective Tables of regular History to the ninth Article.
24. A Table of the Affinities, or Relations of Motion.
25. Collective Tables of regular History to the tenth Article.
26. A Table of the uniting Powers in Motion.
27. Collective Tables of regular History to the eleventh Article.
28. A Table of the Powers of Customs and Innovations in Motion.
29. Collective Tables of regular History to the twelfth Article.
30. Tables of all the other Observables of Motion, not mentioned above.
31. A Table of Indications; or the primary Dissection.
32. A Table of secondary Division.
33. A Table of Observations; or imperfect Axioms.
34. A Table of apparent Impossibilities; or *Desiderata* for human Uses.
35. A Table of occasional Uses in active Life.
36. A Table of imperfect Interpretation.
37. Tables of Transportation, directing of new ones.
38. The *superior Machine* of the Understanding; or a Sequence of Tables upon a Review.
39. New Tables, for changing, diversifying, or transposing the Enquiry^a.

For farther Illustration, take another Example of our *Tabular Method of Enquiry*, in a less general, tho copious Subject; the Affair of *Light and Splendor*.

A TABLE of Enquiries for the particular HISTORY of LIGHT and SPLENDOR.

I. IN the first place, draw up a Table of all those Bodies of every kind, which afford Light: as, (1.) the Stars, fiery Meteors, Flame, Wood, Metals, and other ignited Bodies. (2.) Sugar, in scraping and breaking; Glow-worms; salt Water struck and scattered abroad; the Eyes of certain Animals; rotten Wood; and large Tracts of Snow. Perhaps also the Air itself may have a feeble Light; adapted to the Eyes of such Creatures as see by Night. (3.) Iron and Tin, when put to dissolve in *Aqua fortis*, bubble and boil up, without the Assistance of Fire, and also conceive Heat; but whether

^a This Draught of a general Table may appear somewhat unintelligible, unless the *inductive Method* of Enquiry, delivered in the *Novum Organum*, be previously understood. We do not find that the Author has any where prosecuted the Enquiry into Motion, according to this Model. The Table occurs among the posthumous Pieces published in the *Scripta*, and was, no doubt, intended to be exemplified, illustrated, or filled up, after the same manner as the others of this *fourth Part*. But naked as it is, it has a capital Use; and shews the Way of working in the *Tabular Method*, so as to demonstrate the whole Process both of the Mind and Body, in conducting Enquiries: which is the End it is here proposed to answer. Those who require farther Instruction, may consult any of the other *Tables of Enquiry*, that are prosecuted; as, particularly, that prefixed to the *History of Life and Death*; if the following one, for the History of *Light and Splendor*, be not sufficient. See also the *Novum Organum*, Part II. and the *Preliminary Discourse to the Abridgment of Mr. Boyle's Philosophical Works*.

whether they afford any Light must be farther examined. (4.) The Oil of Lamps sparkles in severe cold Weather; and a certain degree of Light has sometimes been observed, in a clear Night, about a sweating Horse; and sometimes also, tho rarely, about the Hair of Men's Heads, in the nature of a feeble, lambent Flame. A Woman's Stomacher has also been observed to shine upon rubbing; but as the Colour thereof was Green, and Alum is an Ingredient in that Dye, it was probably owing thereto; for it also crackled a little when it shone: but whether Alum in scraping, or pounding, affords Light, should be farther examined; tho the Force applied to it for this Purpose, must, perhaps, be greater than that used to Sugar; it being a more stubborn Body. Some Stockings also have been observed to shine, in pulling them off; whether this proceeded from Sweat, or from Alum used in the Dye. Let all such Instances be collected, and orderly disposed into this first, or *Presence Table*; to shew in what Subjects the thing we enquire after resides.

2. In the next place, let a Table be formed of such Bodies as yield no Light at all; and yet have a great Resemblance with those that do. Thus, boiling Water affords no Light; nor Air, tho violently heated. Looking-glasses and Diamondsⁱ, which reflect Light so very remarkably, yet yield none that is original, and their own; with other Instances of the like kind: and among them, let a diligent Enquiry be made after those we call *Traveling Instances*; that is, where Light is present and absent, transiently or by turns: thus an ignited Coal gives Light, yet if strongly compressed it presently ceases to be luminous: but the crystalline Matter of the Glow-worm, tho broken and divided into Parts, retains its Light for a small time, tho it vanishes soon after. And this whole Collection of Instances, ranged in proper Order, will form what we call the *Absence Table*; and exhibit all the Bodies wherein the Subject enquired after does not reside; tho they nearly approach to those wherein it does reside.

3. Let it be next enquired, what Light is more, and what less intense and vibratory. Thus the Flame of Wood yields a strong Light; the Flame of Spirit of Wine a weaker; and the Flame of Coals thoroughly ignited, yields a Light that is dusky, and scarce visible. And the proper Instances of this kind, collected, will furnish out what we call the *Degree Table*.

A R T I C L E I.

The Colours of Light.

LET the Enquiry next proceed to the Colours of Light, to shew what they are; and what they are not. Some of the Stars are white, others shining; some reddish, and others livid. Common Flames, Corruscations of the Air, and the Flame of Gun-powder, are principally whitish; but the Flame of

T t 2

Sulphur

ⁱ Do not Diamonds, under certain Circumstances, afford a Light in the dark? See *Boyle* and *Stahl*.

I N T R O D U C T I O N.

Sulphur beautifully blue. Some Bodies also yield purple Flames ; but there have hitherto been discovered no green ones : tho the Light of the Glow-worm has a tendency thereto. Scarlet Flames also have not been observed : but ignited Iron is red ; and when intensely ignited, whitish. But all the Instances of this kind are to be collected, and thrown into a Table, to shew all the Variety of Colours in Light.

A R T I C L E II.

The Reflections of Light.

1. **L**ET it be next examined, what Bodies reflect Light : as Speculums, Water, polished Metals, the Moon, and Gems. All fluid Bodies, and those that have a very smooth and even Surface, afford some degree of Splendor ; which is no other than a faint degree of Light.

2. It must be diligently examined, whether the Light of a lucid Body may be reflected by another that is lucid ; as suppose ignited Iron were exposed to the Sun's Rays : for Light is reflected again and again, from Speculum to Speculum, tho gradually fainter, and weaker.

A R T I C L E III.

The Multiplications of Light.

1. **L**ET the Enquiry next descend to the Multiplication of Light ; as by Speculums, Telescopes, and the like, which have a Power to sharpen Light, and throw it to a great distance ; or else render it more subtle and better disposed for distinguishing visible Objects ; as we see by the Practice of Jewellers, and other Artists, who set a spherical Glass of Water between the Candle and their Work.

2. It must likewise be examined, whether all Bodies, when in a large Quantity, do not reflect Light ; for 'tis very probable that Light must pass thro', or be reflected. And thus the Moon, tho it were an absolutely opaque Body, yet might, on account of its Magnitude, reflect Light. Let it likewise be examined, whether the Approximation of lucid Bodies does not multiply Light ; which, in Bodies that are equally lucid alike, cannot be doubted : but whether the Light which is totally over-powered by a greater Light, so as of itself to be rendered invisible, does not yet add some quantity of Light, must be farther examined. Even glossy Bodies contribute to the Increase of Light ; for a Chamber hung with Silk, is lighter than when hung with Cloth. Light is also multiplied by Refraction ; for Gems that are cut with Angles, and broken Glass, are more splendid than when plain, or entire.

ARTICLE IV.

The Ways of Drowning Light.

THE Methods of Drowning Light should next be enquired into ; as by the Predominancy of a greater Light, the Grossness or Opacity of the Medium, &c. Thus, the Sun's Rays playing upon a culinary Fire, causes the Flame to appear as a certain white kind of Smoke. All the Instances of this kind should be collected.

ARTICLE V.

The Operations, or Effects of Light.

THE Operations or Effects of Light, come next to be examined ; tho they seem to be but few, and have little share in bringing remarkable Changes upon Bodies, especially those that are solid : for Light, above all things, generates itself, and other Qualities, but sparingly ; however, it certainly attenuates the Air, is grateful, and chearing to the Spirits of Animals, excites the languishing Rays of Colours, and visible Objects ; for Colours are nothing more than the refracted Image of Light. But the Particulars of this kind are to be diligently hunted up, and collected.

ARTICLE VI.

The Continuance of Light.

THE Continuance of Light may be next examined, tho it seems to be but momentary ; for notwithstanding Light has continued in a Chamber many Hours, it illuminates the Chamber no more than it did the first Moment : but the Case is quite otherwise in Heat, &c. for the first Heat remains, and a new one is superadded thereto. The Twilight is, by some, conceived to be the Remains of the Sun's Light.

ARTICLE VII.

The Directions, Motions, and Passages of Light.

THE Directions, Motions, and Passages of Light, should be very attentively examined. Light is diffused all round ; but whether at the same time it ascends a little, or is equally diffused upwards and downwards, must

must be enquired into. Light produces Light every where about it ; so when the Body of a Taper is not perceived thro' the Interposition of a Blind, or Obstacle, it still illuminates all the Objects around it ; excepting those that are in the Shadow of the Veil. And yet even these Objects are somewhat illuminated by the Light thrown about them ; for an Object standing within this Shade, may still be much better perceived than if no Light at all were present : and therefore the visible Body of any luminous Matter, and Light itself, are two very different Things. Light does not penetrate fibrous Bodies, of an irregular and disorderly Texture ; tho it still is not hindered by Solidity and Hardness ; as we can see in Glafs, &c. and therefore only strait lined Bodies, whose Pores lie not transverse, seem capable of transmitting Light.

Light is excellently transmitted thro' the Air ; which the purer it is, the better the Light passes. But whether Light be convey'd by the Body of the Air, as Sounds are by the Winds, or in any other manner, should be examin'd ; with other Matters of the like kind, to complete this Article.

A R T I C L E VII.

The Transparency of luminous and lucid Bodies.

IT should next be examined, what lucid or luminous Bodies are Transparent. The Wick of a Candle is perceived thro' the Flame ; but Objects are not visible thro' large Bodies of Flame. On the other hand, all Transparency is lost in a Body upon Ignition ; as appears in Glafs. The Body of the Air is transparent ; so is Water : but when these two transparent Bodies are mix'd together in Snow or Froth, they no longer preserve their Transparency ; but acquire a certain original Light.

A R T I C L E VIII.

The Agreements and Disagreements of Light.

THE Agreements and Disagreements of Light must be enquir'd into. Light has a principal Correspondence and Affinity with three Things, as to its Generation, viz. Heat, Subtily, and Motion ; the Conjunction and Separation whereof, in respect of Light, must therefore be examined, together with their Degrees. The Flame of Spirit of Wine, or the *Ignis fatuus*, is much milder in Heat, but stronger in Light than ignited Iron. Glow-worms, the dewy Vapor rais'd by the dashing of Salt-water, and many other Things abovemention'd, yield Light, tho they are not warm to the Touch. Ignited Metals are not subtle Bodies ; yet they have a burning Heat. On the contrary, Air is one of the subtlest Bodies, yet has no Light. Again, Winds, tho very rapid in their Motion, afford no Light. Contrariwise, ignited Metals have but a dull and languid Motion, yet vibrate Light.

But

But there is nothing so nearly related to Light, not indeed with regard to its Generation, but only to its Passage, as Sound; and therefore their agreements and disagreements are to be diligently sought. Some of their Agreements are these. (1.) They both diffuse themselves in a Sphere, (2.) They both move to very great Distances; but Light the swiftest; as appears in the discharging of Cannon, where the Light is first perceiv'd before the Sound, and the Flame follows after. (3.) They have both very *subtile Differences*; Sounds in the Articulation of Words, and Light in all the Images of visible Things. (4.) They both produce or generate little; except in Senses and Spirits of Animals. (5.) They both are easily generated, and soon vanish. (6.) Light is drowned by a greater Light; and Sound by a greater Sound, &c.

Some of their Differences are these. (1.) Light moves swifter than Sound. (2.) Light moves farther than Sound; (3.) Light moves only in a strait Line; but Sound obliquely and every other way. For when an Object is perceived in the shade of an Obstacle, 'tis not because the Light penetrates the Obstacle, but only illuminates the Air round about; whence the Air behind the Obstacle is also somewhat illuminated. But a Sound begun on one side of a Wall, is heard without much Diminution on the other. And again, Sound is heard from within a solid Body, as in the Eagle-stone, or from Bodies struck under Water: But Light is not at all perceived in a transparent Body, that is every way obstructed or surrounded. (4.) Lastly, all Sound is generated in Motion, and a manifest stroke of the sounding Body; which in Light is otherwise.

But for the Disagreements of Light, there have been none hitherto observed, unless Privations may be call'd Disagreements. And it should seem that sluggishness in the Parts of Bodies is the greatest Enemy to Light; for scarce any Thing is luminous that is not in its own Nature remarkably moveable; or easily excited, either by Heat, Motion, or vital Spirit: but this Enquiry should be further prosecuted. And we always mean, not only that other new Instances should be diligently sought out, in Conformity with those few which we only produce as a Specimen; but likewise that new Articles, and Tables of Enquiry, should be set down, added, and drawn, up as the Nature of the Subject directs or requires *.

T H E

* This Subject of *Light* is prosecuted to a considerable length by Dr. Hook, in his *Lectures of Light*; by Mr. Boyle, in his *Experiments and Observations upon Colours*; M. Huygens de la *Lumière*; and since by Sir Isaac Newton, in his *Treatise of the Reflections, Refractions, Inflections, and Colours of Light*.

THE
HISTORY
OF
LIFE and DEATH.

VOL. III.

U u

A
DELINEATION
OF THE
PARTICULAR HISTORY
OF
LIFE and *DEATH*;

With a View to
PRESERVE HEALTH,
RETARD OLD-AGE;

AND
Lengthen the present Period
OF
HUMAN LIFE.

P R E F A C E.

THE Subject of human Life and Death is, of all natural Subjects, the most interesting to Men; and, as such, the Author has treated it with uncommon Diligence. The Enquiry is conducted in the inductive Method; and carried to a considerable Length: with Directions for continuing it still farther, till we arrive at a Knowledge of the Cause and Form of Life and of Death. The whole being left in such forwardness, it may naturally be asked why it has not been since brought nearer to Perfection? The principal Reason I can assign is, that Physicians have been otherwise employ'd: and Men of different Professions seem discouraged from improving an Art they do not practise. The Disease is easier found than the Remedy. Nor can a capital Remedy, in this Case, be expected till Men shall, in some degree, have conquer'd their Passions; and shew a less regard to private, and a greater to publick Good. The Author, has shewn by an illustrious Example, that Persons of a publick Spirit, might, tho they were not bred to Physick, treat the Subject of Life and Death to Advantage.

That the full Scope and Conduct of the Piece may be understood, it will be proper to remember the Doctrine laid down in the second Part of the Author's *Novum Organum*; concerning the Method of prosecuting Enquiries.

I N T R O.

INTRODUCTION:

TH E Shortness of Life, and the slow Advancement of Arts, has been an ancient Complaint. 'Tis therefore agreeable to our Design of bestowing the utmost Pains upon the perfecting of Arts, to consider also the Ways of prolonging human Life. But this Enquiry is pressed with Difficulties ; the rather, because of false Notions and Opinions concerning it : for what the Physicians have frequently in their Mouths, about radical Moisture, and natural Heat, are but delusory Conceits ; and the extravagant Commendations of chemical Medicines, do but first swell up, and then disappoint our Hopes *.

The present *Enquiry* is not directed to that kind of *Death* which proceeds from Suffocation, Putrefaction, and Diseases ; for this belongs to *Medicinal History* : but to that Death only, which comes on by Resolution, and a Wasting of the Parts, thro' Old-Age. The last Step, indeed, of *Death*, or the total Extinction of Life, (which may happen so many Ways, both external and internal ; tho they have all of them, as 'twere, one common Avenue at last,) has some relation to our Design : and brings up the Rear of the *Enquiry*.

Whatever may be gradually repaired, without Destruction to the original Whole, is, like the *Vestal* Fire, potentially eternal : whence Physicians and Philosophers, observing that Animals are totally nourished, and their Bodies recruited and supplied, tho not for any long Continuance ; but soon after grow old, and hasten to a Dissolution ; they have sought for *Death* in a Subject not properly capable of Repair : and judged, that a certain radical, and primitive Moisture, could not be totally recruited ; but that there was a certain spurious Apposition of Parts, and not a just Repair, carried on from Infancy, and gradually degenerating with Age ; till, at length, this Depravity ends in Non-existence.

This is but a crude and flashy Notion ; for all the Parts of an Animal in youth, and in a growing State, are totally repaired ; and, for a time, not only improved in Quality, but augmented in Quantity : insomuch that the recruiting Matter might be, in some measure eternal, if the Manner of Recruiting did not fail. But here lies the Case, that in declining Age, the Repair is made very unequally ; some Parts being successfully nourished, but

* The Virtues of Pharmaceutical Preparations are so unsettled, that 'tis generally little more than Levity, to extol or decry particular Remedies.

† See the *Introduction* to the *Sylva Sylvarum*, pag. 24, 25. of this Volume.

but others with difficulty, and for the worse : so that from this time, animal Bodies begin to suffer the *Mezentian* Torment, of having the live Parts die in the Embraces of the dead ones ; those that are easily reparable failing, thro' their Conjunction with such as are not : for when Age is upon the Decline ; the Spirit, the Blood, the Flesh, and the Fat, are easily repaired ; but the dryer, or more spongy Parts ; the Membranes, the Coats, the Nerves, the Arteries, the Veins, the Bones, the Cartilages, most of the *Viscera*, and nearly all the organical Parts, are repaired with Difficulty, and Loss.

And as these Parts must of Necessity officiate in the actual Repair of the more reparable Parts ; but, being thus diminished in their Activity and Powers, can no longer perform their Functions ; it follows, that all of them soon begin to languish ; and the Parts, in their own Nature most reparable, now wanting the service of the Organs of Repair, can no longer be commodiously supplied ; but impoverish by degrees, and at length totally fail.

The *Cause* of this Revolution lies here, that the Spirit, like a gentle Flame, is perpetually preying upon the Parts^a ; and in Conjunction with the external Air, which also drinks and dries up tangible Bodies, at length destroys the Work-shop of the Body, its Instruments and Machines ; and thus renders them unfit for performing their Office. And this is the true Process of *natural Death* ; which requires to be thorowly considered : for *he who knows not the Ways and Courses of Nature, can never oppose and bend her*^a.

This *Enquiry*, therefore, consists of two Parts ; with respect, (1.) to the Consumption or Depredation of the Body ; and, (2.) to its Repair, or Recruit : with a View, as much as possible, to prevent the former and promote the latter. The *first* has a principal Regard to the Spirit, and external Air, which make the Depredation ; and the *second*, to the entire Process of Alimentation, which supplies the Repair.

The *Enquiry of the Consumption* has many Things in common with inanimate Bodies : for the Effects which the innate Spirit, residing in all tangible Substances, whether animate or inanimate, and which the external Air produces upon inanimate Bodies, are likewise endeavoured upon animate Bodies : whilst the Interposition of the vital Spirit, on one side, checks and restrains their Operations ; and, on the other, powerfully promotes them. For 'tis plain, that many inanimate Bodies may endure a long time without Repair ; whereas animate Bodies presently fail, without Nourishment and Recruit ; thus, like Fire, becoming extinct.

Our *Enquiry* therefore must be double ; and regard first the human Body, as a thing inanimate and unsupported by Aliment ; and secondly, as a thing animate and nourished^a.

And

^a Let this Consideration, of the Spirits preying upon the other Parts, be duly regarded : it is of great Importance to what follows. See *Señt.* I. 13, 14.

^d As it is necessary he should do, who would endeavour to lengthen the present Period of Human Life.

^e Observe the Sagacity and Judgment in distinguishing and fixing the two capital Points of the Enquiry.

And this *Enquiry*, we hope, might redound to a general good; if Physicians would but exert themselves, and raise their Minds above the sordid Considerations of Cure: not deriving their Honour from the Necessities of Mankind; but becoming Ministers to the divine Power and Goodness, both in prolonging and restoring the Life of Man: especially as this may be effected by safe, commodious, and not illiberal Means; tho' hitherto unattempted^d. And certainly it would be an Earnest of the divine Favour, if, whilst we are journeying to the *Land of Promise*, our Garments, these frail Bodies of ours, were not greatly to wear out in the Wilderness of this World.

S E C T. I.

The General TABLE of ENQUIRY; or a Set of Heads for the particular HISTORY of Human Life and Death; with Directions for the Conduct of the whole.

A R T I C L E I.

A Previous Enquiry into the Nature of Durability; and its Degrees, in inanimate and vegetable Bodies.

This Article to be prosecuted, not at large, or in due form; but concisely, by certain Heads; and as in Passage^e.

A R T I C L E II.

OF Dryness, Arefaction, and the Consumption of inanimate Bodies and Vegetables; with the Manner and Process they succeed in, and the Ways of preventing and retarding all three: the preserving of
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^d See hereafter, *Señ. VIII.*

^e It may be proper to observe at the Entrance of this Piece, that each *Section* is what the Author understands by a *Table*, which is formed at many different Operations of the Mind, in the way of so many *Steps*; whence the whole Enquiry being artificially broke into a number of distinct and commodiously manageable Parts, the Mind both at first, and ever afterwards, operates with the greater Ease, Freedom, and Advantage. For thus every *Table* is a separate Work, not finished; but left still open to receive farther Additions and Improvements. And when all the *Tables* shall be perfected, then, and not till then, will the whole Enquiry be finished. So that the Understanding has many more Steps to take, before it arrives at a plenary Knowledge of the *Form of Life and Death*. This Advertisement may be less necessary to those who are versed in the Author's Method of Enquiry, laid down and exemplified in the second Part of his *Novum Organum*.

^f The Directions, occasionally subjoined to these Articles of Enquiry, were not only intended to regulate the Conduct of the Author; but, likewise, the Conduct of all future Enquirers into the same Subject.

The HISTORY of LIFE and DEATH.

Bodies in their own State ; and lastly, a more careful Enquiry into the Ways of softening, mollifying, malaxing, and recovering of Bodies after they once begin to be dried.

Nor is a perfect, rigorous *Enquiry* necessary under this Article ; both as these Particulars may be deduced from their proper Head of *Durability*, and are not capital Things to the present Purpose ; tho they afford Light to the Way of prolonging and restoring Life in Animals.

From inanimate and vegetable Bodies, let the Enquiry descend to Animals, exclusive of Man.

ARTICLE III.

OF the Long and Short Life of Animals ; with the proper Circumstances which seem to have a Share in the Difference.

ARTICLE IV.

AS the Duration of Bodies is of two kinds ; the one consisting in simple Identity, the other in Repair ; the first whereof obtains only in Bodies inanimate ; the second, in Vegetables and Animals, and is performed by Alimentation ; the next step of the Enquiry must be, into the Business of Alimentation, with its Ways and Process.

Neither is Exactness required here ; because this belongs to the Heads of *Assimilation* and *Alimentation* : and need only be touched, as the former, in Passage.

The Enquiry must next descend to *Man* : and as this is the principal Subject of all, the Procedure should be here, in every respect, exact and perfect.

ARTICLE V.

AN Enquiry into the Length and Shortness of Life in Men, according to the different Ages of the World, Countries, Climates, Places of Nativity, and Habitation.

ARTICLE VI.

OF the Length and Shortness of Life in Men, with regard to their Origin and Propagation, as it were in an Hereditary Manner ; also with regard to their Complexions, Constitutions, Habits of Body, Stature, manner and periods of Growth, and the formation and knitting of the Limbs.

ARTICLE VII.

OF the Length and Shortness of Life in Men, according to the Times of their Nativity : this Enquiry being so conducted, as at present to drop all astrological and horoscopical Considerations; and receive only the more manifest and common Observations, if there be any; such as Birth in the seventh, eighth, ninth, and tenth Month, happening by Night or by Day, or in different Months of the Year.

ARTICLE VIII.

OF the Length and Shortness of Life in Men, with regard to their Food, Diet, manner of Living, Exercise, &c. the Considerations of the Air which Men breathe, belonging to the fifth Article, under the Head of Habitation.

ARTICLE IX.

OF the Length and Shortness of Life in Men, with regard to their Studies, kinds of Life, Passions of Mind, and various Accidents.

ARTICLE X.

A Separate Enquiry into such Remedies as are thought to prolong Life.

ARTICLE XI.

OF the Signs and Prognosticks of long and short Life : not such as denote Death at hand; which belong to medicinal History; but such as appear, and are observed, even in Health; whether derived from Physiognomy, or other Considerations.

Thus far the Enquiry proceeds upon the Length and Shortness of Life, in an artless and miscellaneous manner : whereto 'tis proper to add an artificial Enquiry, tending to Practice, by three general Intentions. We shall lay down the more particular Distributions of these Intentions when we come to the Enquiry itself. Let it only be observed for the present, that these three general Intentions are, the Prevention of Waste, the Perfecting of Recruit, and the Renovation of Decay.

X x 2

ARTICLE XII.

* See hereafter, Sect. VIII.

The HISTORY of LIFE and DEATH.

ARTICLE XII.

AN Enquiry into those Things which preserve and exempt the human Body from Arefaction and Consumption; or at least retard and ward off the Tendency thereto.

ARTICLE XIII.

AN Enquiry into the Particulars belonging to the entire Process of Alimentation; whereby the Body of Man is recruited, in order to its Perfection, and the Prevention of Loss.

ARTICLE XIV.

OF the Things which discharge the worn-out Materials; supply new ones; and supple and moisten the Parts that are dried and indurated.

But as 'tis difficult to know the Ways of Death, before its Seat is discovered, this also must be enquired into; tho not with regard to all kinds of Death; but such only as proceed, not from Violence, but from Privation, and want of Supply: for this kind alone belongs to the Wasting of the Body by Age.

ARTICLE XV.

AN Enquiry into the Point of Death, and the Avenues leading up to it, on all Sides; thro' want of Supply, and not thro' Violence.

And as it is proper to understand the *Characteristick* and *Form of Old Age*, this *Enquiry* must not be omitted; and is best made by diligently collecting, and comparing together, all the Differences in the State and Functions of the Body, happening betwixt Youth and Old Age; which, at length, will shew what the Thing is that shoots out into so many Effects.

ARTICLE XVI.

A Careful Enquiry into the different States of the Body, in Youth and Old Age; observing if there be any thing that remains the same unimpaired in Age^h.

S E C T.

^h Here the Author ends his own Enquiry; leaving every Article open to receive the Improvements of others: only, in his usual manner, endeavouring to raise a Set of AXIOMS and CANONS, upon what is already discovered, in the way of First-fruits, and Earnests of greater Things.

SECT. II.

The History of Durability; with regard to the first Article of the Table of Enquiry^k.

1. **M**ETALS are so lasting, that the Observation of Mankind is not sufficient to fix the time of their Duration: even when resolved by Age, they are but turn'd to Rust, without loss of Parts; tho Gold suffers neither of these Changes^l. *The durability of Bodies inanimate, viz. Metals.*

2. Quicksilver, tho a Fluid, and extremely volatile in the Fire, is not known either to waste or rust by Age alone, without Heat. *Quicksilver.*

3. Stones, especially the harder Kinds, and many other Fossils, are exceeding durable; even tho exposed to the open Air; much more when buried under Ground. Stones, however, gather a kind of Nitre^m, after the manner of Rust: but Gems and Crystals are more durable than Metals; tho they lose somewhat of their Splendor with great Length of Time. *Stones.*

4. 'Tis observed, that Stones are sooner consumed on the side exposed to the North, than on that exposed to the South; as appears plainly in Pyramids, Temples, and other Buildings: whilst Iron, on the other hand, rusts faster on the side exposed to the South than to the North; as we find by the Iron Bars of Windows: and no wonder; since in all Putrefactions, and Rust is one, Moisture promotes the Dissolution, as Dryness does in simple Arefaction.

5. Vegetables severed from the Earth, and the Trunks of the harder Trees, Timbers, &c. endure for some Agesⁿ. But the parts of the Trunk are different; some Trees being fistulous, as the Alder, where the Pith in the middle is soft, and the external part hard: but in Timber Trees, as the Oak, the inner part, call'd the Heart of the Tree, is most durable. *Vegetables.*

6. The Leaves, Flowers, and even Stalks of Plants are of small Duration; and either putrefy or resolve to Dust and Ashes: the Roots being the more durable Parts.

7. The Bones of Animals last long; as we see in Charnel Houses. Horns and Teeth are very durable; as appears in Ivory, and the Tooth of the Sea-Horse. *Animal Substances.*

8. Skins,

^k See pag. 337.

^l Unless its proper Menstruum, the Fumes or Spirit of Sea Salt, happen to meet with it, Remark all along the Author's Method of proceeding by Induction; or a Collection of Facts, Observations and Experiments; which when duly tabled, as so many *Data*, give the *Quasita*.

^m I suppose this is meant of the *Nitrum Murale*.

ⁿ There are certain Trees, which in a very few Years turn to Moss, or mould, by lying buried in the Ground, See Mr. Evelyn's *Sylva*, and the *Philosophical Transactions*.

8. Skins, Hides, and Leather are also durable ; as appears from the ancient Manuscripts on Vellum, &c. Paper also will last many Ages ; tho it is less durable than Parchment.

*Bodies that
have pass'd the
Fire.*

9. Bodies by passing the Fire are render'd more durable ; as Glass, Bricks, &c. Even Flesh and Fruits that have felt the Fire, prove more durable than when crude : not only because the Fire prevents Putrefaction, but because when the aqueous Moisture is gone, the unctuous Moisture supports itself the longer.

*Water and
Oil.*

10. Of all Liquors, Water is soonest absorbed by the Air ; but Oil, on the contrary, exhales slowly, as appears both in the Liquors themselves, and again when mix'd with other Bodies : for Paper dip'd in Water, acquires some degree of Transparency, but soon loses it again, and turns white, thro' the Exhalation of the Water ; whereas Paper dip'd in Oil, long remains transparent, because the Oil does not exhale.

Gums.

11. All Gums are exceeding durable ; so likewise is Wax and Honey.

*An uniform
state requisite
to durability.*

12. But equability and inequability in the accidental Circumstances of Bodies have as great a share in the duration or destruction of them as Things themselves : for Timber, Stones, &c. lying continually either in Water or in Air, last longer than if they were sometimes removed from the one to the other. So Stones, laid in Buildings with the same Direction, as to the Points of the Compass, they had in the Quarry, prove more durable than they otherwise would ; and the Case is the same in removing of Plants °.

Two larger Observations.

*Two capital
Observations
with regard to
the Spirits in
Bodies.*

13. Let it be held as certain, that there is in all tangible Bodies a Spirit, or pneumatical Substance, enveloped and included in the tangible Parts ; and that this Spirit is the Origin of all Dissolution and Consumption ; which are therefore to be prevented by the detention of this Spirit.

14. This Spirit is detain'd two ways ; either by close Compression and Confinement, or by a kind of spontaneous Residence. And this Lodgment is solicited two ways ; viz. if the Spirit itself be not very moveable or sharp ; and again, if it be not excited by the external Air to desert. So that there are two durable Substances, a hard one and an oily : the first constringes the Spirit, and the second in some measure appeases it ; and is less solicited by the Air, for Air is of the same Substance with Water ; and Flame with Oil.

*The Duration
of Plants. The
Cold.*

And so much for the Nature of *Durability* in Bodies inanimate.

15. The Plants accounted cold, are annual, and die yearly, both in their Root and Stalk ; as Lettuce, Purslane, Wheat, and all Kinds of Grain : yet there are some cold Plants which last for three or four Years ; as the Violet, Strawberry, Pimpernel, Primrose and Sorrel ; but Borage and Bugloss, tho so like when alive, differ in death : for Borage is but annual ; whereas Bugloss lasts longer than one Year.

16. Nume-

° Is this sufficiently verified ?

p Let the justness of these larger Observations, and their importance, be thoroughly perceived.

16. Numerous hot Plants bear Age well ; as Hyssop, Thyme, Savory, *The Hot.* common Marjoram, Baulm, Wormwood, Germander, Sage, &c. but Fennel dies yearly in its Stalk, and shoots again from the Root : whereas Basil and sweet Marjoram endure Age better than they do the Winter ; for when planted in a warm and well fenced place, they flourish above one Year : and a Bed of Hyssop, clipt every six Months, has been known to continue forty Years.

17. Shrubs and Buthes continue flourishing for sixty Years, and some for twice that time. The Vine may live to sixty, and be fruitful even to the last. Rosemary well secured, will likewise reach to sixty ; and Bear's-foot, and Ivy to more than a hundred. The Age of the Bramble cannot be well computed ; because bending to the Earth, it strikes fresh Roots ; so that 'tis hard to distinguish the new Shoot from the old. *The duration of Shrubs.*

18. Among large Trees the longest lived are the Oak, the Holm, the *Of large Trees.* Ash, the Elm, the Beech, the Plane, the Fig, the Lote, the Olive, the wild Olive, the Palm and the Mulberry : some of these will last eight hundred Years ; and the shortest Livers of them all, two hundred.

19. But odoriferous and resinous Trees are in their Matter or Wood still more durable. 'Tis true, the Cypress, the Fir, the Pine, the Box, and the Juniper, are shorter Livers ; but the Cedar, assisted by the bulk of its Body, nearly equals the abovementioned. *The odoriferous and resinous kind.*

20. The Ash, brisk and quick in its Growth, lives to a hundred Years *The Ash, &c.* or more ; so likewise do the Birch, the Maple, and the Service-Tree : but the Poplar, the Lime, the Sycamore and the Walnut are not so long lived.

21. The Apple, the Pear, the Plumb, the Pomegranate, the Citron, *Fruit Trees,* the Lemon, the Medlar, the Cornel, and the Cherry-tree, may last fifty or sixty Years ; especially if now and then scoured of their Moss, which surrounds some of them.

22. In general, Largeness of bulk in Trees, where other Things are equal, has some Affinity with their Continuance of Life ; so likewise has hardness of Subitance : and such as bear Mast and Nuts are generally longer lived than Fruit-trees. So again, those that are late, either in Fruit or Leaf, and also shed late, are longer lived than such as bear and shed early : So wild Trees, are longer lived than those of the Orchard ; and of the same kind such as bear an acid Fruit live longer than such as bear a sweet one. *Largeness has some relation to durability.*

A larger Observation.

23. *Aristotle* has excellently observed the difference between *Plants* and *Animals*, in point of Nourishment and Recruit, viz. that the Bodies of *Animals* remain confined within their own Bounds ; so that when come to a due magnitude, they are supported and preserved by their Aliment, without the new growth of any thing but Hair and Nails, which are accounted excrementitious ; whence of necessity the Juices of *Animals* sooner grow old : whereas *Trees* often put out new Branches, new Shoots, new Leaves, new Fruits ; *A Capital Observation of the difference betwixt the nourishment of Plants and Animals.*

Fruits ; whence also, the other parts become new, and feel not the effects of Age ; because whatever is green and young, more briskly and strongly attracts the Nourishment to itself, than what has begun to grow dry ; insomuch that the Trunk itself, thro' which the Sap is conveyed to the Branches, thus comes to be watered, and supplied with a more rich and plentiful Aliment : as remarkably appears from hence, that in the cutting of Hedges, the lopping of Trees, and the thinning of Coppices, the Stem or Trunk is always invigorated, and render'd much longer lived by the loss of its Shoots, or Branches.

S E C T. III.

The History of Desiccation, the prevention thereof, and the softning of dry'd Bodies : with regard to the second Article of the Table of Enquiry.

Desiccation by Fire.

FIRE, or intense Heat, dries some Bodies, and melts others : it dries Earth, Stone, Wood, Cloth, Hides, and all Bodies incapable of melting ; but fuses Metals, Wax, Gums, Fat, &c.

2. Even those Things that melt in the Fire are dry'd by it at last ; if the Fire be increased. Thus Metals, with a violent Heat lose their volatile Part ; and all of them, except Gold, become lighter and more brittle : and by a strong Fire, oily and fat Bodies, become scorched, dry and crusty.

By Air.

3. The open Air is manifestly drying, but never melting ; thus the Surface of the Earth is dried after being wet with Showers ; so Linnen is dry'd after washing, by exposing it to the Air ; and Herbs, Leaves and Flowers are dry'd in the Shade, &c. but the Air performs this much more powerfully, when assisted by the Sun's Rays, or put into Motion, as by Winds, &c.

Age.

4. Age has a great, tho' an exceeding slow power of drying, as we see in all Bodies ; which, unless prevented by Putrefaction, grow dry with Age : yet Age is nothing of itself ; or no more than the measure of Time : but the Effect is produced by the native Spirit of Bodies, which drinks up their Moisture, and flies off together with it ; whilst the external Air multiplies

4 Whence in effect, the Trunk becomes continually young again. This Observation, therefore, is of great importance to the present Enquiry ; as it may in some degree be transfer'd from vegetable to animal Subjects ; and afford a Rule for procuring a kind of Rejuvenescency ; as by the use of Frictions, &c. on the external Parts of the Body, so as to perspire the old Juices ; and cause those Parts more strongly to attract new ones.

5 Even Gold itself loses of its weight, and becomes a purple Glass, when exposed to the Focus of a large Lens, or burning Concave. See M. Homberg's Paper upon the Subject. *Memoir. de l'Acad. An. 1702.*

6 Do not all Bodies after complete Putrefaction, become dry and truly terrestrial ?

multiplies itself thereon, and preys upon the native Spirit and Juices of Bodies †.

5. But Cold is, properly, the greatest Dryer of all : for there can be no Cold; Dryness without Contraction, which is the proper Effect of Cold. But as we have a powerful degree of Heat in Fire, and only a very feeble one of Cold, as that of the Winter, Snow, Ice, &c. the Arefactions of Cold are but weak on the Earth, and easily destroy'd ; yet we find the face of the Earth more dry'd by Frost, and March Winds, than by the Sun ; whilst the same Wind that licks up the Moisture produces Cold ‡.

6. The Smoak of Fire gives Dryness, as we see in the case of Flesh suspended in Chimnies ; and so the fumigations of Frankincense, *Lignum Aloe*, &c. dry the Brain, and stop Defluxions.

7. Salt by continuance dries, not only externally, but deeply ; as appears in the salting of Flesh or Fish ; which lying long in the Salt are manifestly hardened, even internally.

8. Hot Gums applied to the Skin, dry and wrinkle it ; so likewise do some astringent Liquors.

9. High rectified Spirit of Wine dries almost like Fire ; so far as to harden and blanch the white of an Egg put into it, and almost to scorch up Bread.

10. Powders dry like Sponges, by sucking up Moisture ; as we see in throwing Sand upon fresh writing. Even a Polish, or the close union of a Body, not permitting a moist Vapour to enter its Pores, dries by accident ; as exposing the Subject to the Air. Thus Gems, Looking-glasses and Sword-blades, when breathed upon, appear at first cover'd over with a Vapour, which presently vanishes like a light Cloud. And so much for the Article of *Desiccation*.

11. In the Eastern Parts of Germany they make use of subterraneous Granaries, for preserving their Corn, by laying Straw at the bottom, and all around to some height, in order to repel and suck up the humidity of the Cave ; by which means they keep their Grain for twenty or thirty Years not only uncorrupted, but, what makes to the present Enquiry, in such a state of freshness, as excellently fits it for the making of Bread. And the like Practice, 'tis said, has formerly prevail'd in *Cappadocia*, *Thrace*, and some parts of *Spain*. *Prevention of Desiccation instanced in subterraneous Granaries.*

12. Granaries are commodiously made in Garrets, or upper Rooms, with Windows open to the East and North : and some have two Floors, an upper and a lower for this purpose ; the upper one being perforated, that the Grain may continually fall thro' the Holes thereof, like Sand in an Hour-glass,

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† This might pass for a larger Observation, of capital Import.

‡ A freezing degree of Cold even dries up Water ; or turns it from a Fluid into a Solid. And a still greater degree will congeal Wine, Brandy, Oil of Vitriol, and other mineral acid Spirits : a still higher might congeal Quicksilver itself ; tho this was never experienced in the ut most degrees of Cold that Men have hitherto been able to produce ; not even by the mixture of Spirit of Nitre and Ice.

glafs, and ſome Days after be again thrown back with Shovels; ſo as to keep the Grain in continual Motion: by which Contrivance, Corruption is not only prevented, but Freshneſs preſerved, and Dryneſs retarded; the *Cauſe* whereof, as we intimated above^u, is the diſcharge of the aqueous Moiſture, which being accelerated by the Motion of the Wind, preſerves the oily Moiſture in its ſtate, that wou'd otherwiſe fly off along with the aqueous. And thus on certain Mountains, where the Air is pure, dead Corps will remain many Days unfaded.

13. Fruits, as Apples, Pears, Lemmons, &c. and Flowers, as Roſes, Lillies, &c. may be long kept freſh in cloſe ſtopt earthen Veſſels; tho indeed the Air from without is ſomewhat prejudicial, by communicating its Inequalities thro' the Veſſel; as manifeſtly appears in the caſe of Cold and Heat: ſo that if the Veſſel were well ſtop'd, it might be a good way to bury it in the Ground^v, or plunge it under Water, that is ſhaded, as Wells and Ciſterns generally are: tho the Bodies to be preſerved under Water had better be put up in Veſſels of Glaſs, than Veſſels of Earth.

14. In general, Bodies repoſited under Ground, and in ſubterraneous Vaults, or deep Waters, preſerve their freſhneſs longer than above Ground.

*Conſervatories
of Snow.*

15. 'Tis related that in Conſervatories of Snow, whether natural or artificial, Fruit has been found as freſh and beautiful, after lying there for ſeveral Months, as if it had been newly gather'd^x.

In Meal.

16. The Country People have a way of preſerving bunches of Grapes, by burying them in Meal; which tho it renders them ſomewhat unpleaſant to the Taſte, yet preſerves their moiſture and freſhneſs: and all the firmer Fruits are not only long preſerved in Meal, but alſo in Saw-duſt; or heaps of Corn^y.

*In Liquors of
the ſame kind
with the Body.*

17. An Opinion has prevail'd, that Bodies are preſervable, freſh and perfect, in Liquors of their own Species; as Grapes in Wine, Olives in Oil^z, &c.

*Fruits how
preſerved.*

18. Pomegranats and Quinces may be well preſerved, by ſleeping them awhile in Salt-water; then taking them out and drying them in the open Air of a ſhady place.

19. Bodies are long preſerved by ſuſpending them in Wine or Oil, much better in Honey or Spirit of Wine; but beſt of all, as ſome ſay, in Quickſilver.

20. Fruits are long preſerved freſh and green, by coating them over with Wax, Pitch, Plaiſter of *Paris*, Paſte, &c.^a

21. 'Tis

^u See above Sect. I. 13, 14. and Sect. III. 3, 4.

^v See a Method of preſerving Fruits and Flowers for a Year, built upon this Foundation, in the *Philosophical Transactions*, N^o 237. p. 44.

^x See Mr. Boyle's *History of Cold*.

^y See the Author's *Sylva Sylvarum*, under the Article *Preservation*.

^z This Opinion ſeems to hold in many Reſpects.

^a Theſe and many other of the following Particulars are farther conſider'd in the *Sylva Sylvarum*; from whence they may appear taken, for the preſent occaſion, according to the deſign of that Piece.

21. 'Tis manifest that Flies, Spiders, Ants, &c. casually included in Amber, or immerled and covered over with the Gums of Trees, never waste afterwards ; tho they are but soft and tender Bodies.

22. Grapes, and other Fruit, are preserved by hanging pendulous : of which situation there is a double Convenience ; for first they are thus preserved from bruising or compresse, to which they wou'd be expos'd by lying upon hard Bodies ; and secondly, the Air surrounds them every way equally.

23. 'Tis observed, that both Putrefaction and Desiccation in Vegetables begin not equally on every side ; but principally in that part thro' which Bodies draw their Nourishment when alive : whence some direct us in preserving of Fruit, to seal up the end of the Stalk with Wax, or melted Pitch.

24. Large Wiecks of Candles or Lamps consume the Tallow or Oil sooner than less ; and the Flame of Cotton sooner than that of Rush, Straw, Twig, &c. and all Flame moved and agitated by the Wind, consumes the Fewel faster than when undisturbed ; and therefore slower in a Lanthorn than in the open Air. 'Tis reported also that sepulchral Lamps will continue burning for a very long time. *The Consumption of Fewel.*

25. The nature and preparation of the Fewel contributes as much to the continuance of the Light, as the nature of the Flame. Thus Wax burns longer than Tallow, wet Tallow longer than dry, hard Wax longer than soft, &c.

26. If the Mould be yearly stir'd about the Roots of Trees, the Trees are of shorter duration ; but, if once in five or ten Years, of longer : So to gather the Buds, and strip off the Twigs of Trees, prolongs their Life. Again, dunging, laying on of Chalk, &c. and much watering, conduces to Fertility ; but shortens the Life of Vegetables. *The manuring of Ground.*

And so much for the preventing of dryness and wasting. The business of softning Bodies once dried, which is the capital Business, in this Case, affords but a few Experiments ; we will therefore join such as belong to Men, and other Animals together.

27. Willow Twigs become more flexible, by steeping them in Water ; so we dip the ends of Birch Rods in Water to prevent their drying : and Bowls of Wood, cleft thro' dryness, being put into Water close again. *The Enquiry of mollifying or suppling the parts once dried in Vegetables.*

28. Very old Trees, that have stood long unremoved, apparently grow young again, and acquire new and tender Leaves, upon digging and opening the Earth about their Roots.

29. Leather, become hard and stubborn by Age, is suppl'd and softned by rubbing it with Oil before the Fire, and in some measure barely by the warmth of the Fire. Skins and Bladders, when somewhat harden'd, grow soft again in warm Water, with the addition of any fat Substance ; but better still if rubbed a little. *In Leather.*

30. Old Draught-Oxen, worn out with Service, being put into fresh Pasture, get new and tender Flesh ; that eats like young Beef. *In Oxen.*

The HISTORY of LIFE and DEATH.

31. A dry and strict Diet of Guaiacum, Bisket, &c. used in the Cure of the venereal Disease, &c. brings Men to extreme Leanness, and consumes the Juices of the Body ; which afterwards beginning to be recruited, grow manifestly more young and fresh : and we judge that emaciating Distempers, being well cured, have prolonged the Lives of many.

Larger OBSERVATIONS.

(1.) Men have a strange Talent, and see sharply in the night of their own Notions ; but wink, and prove weak-sighted in the Day-light of Experience : they talk of the elementary Quality of Dryness, of Dryers, and the natural Periods of Bodies whereby they are corrupted and consumed, without observing any thing of Use, as to the Beginnings, the Means, and the Ends of Dryness and Consumption.

(2.) The Process of Dryness and Consumption consists in three Actions ; and these Actions have their Origin from the native Spirit of Bodies, as was before observed.

(3.) The *first* Action is the Attenuation of Moisture into Spirit ; the *second* is the Exit or Escape of the Spirit ; the *third* is the immediate Contraction of the Parts of the Body after the Spirit is gone : and this last is that Desiccation and Induration we are now principally concerned with ; the two former tending only to consume.

(4.) In the case of Attenuation, the thing is manifest ; for the Spirit included in all tangible Bodies operates without ceasing, and whatever it lays hold of, can digest and work upon, it converts into itself, entirely changes, subdues, multiplies itself thereon, and begets new Spirit. This receives an eminent Confirmation from hence, that Bodies much dried lose in weight, become hollow, spongy, and sonorous from within ; whilst 'tis certain that the internal Spirit contributes nothing to the weight of the Body : whence it necessarily follows, that the internal Spirit must have converted into itself the Moisture and Juice of the Body which before had Gravity ; whence the Diminution of the Weight. And this is the *first Action* ; viz. the Attenuation of the Moisture and its Conversion into Spirit ^b.

(5.) The second Action ; viz. the Escape or Avolation of the Spirit, is likewise manifest ; for when this happens largely, 'tis apparent even to the Sense, in Vapours to the Sight, and in Odours to the Smell ; but when it happens gradually, as it does thro' Age, 'tis then performed insensibly ; tho the Case, in effect, be the same. And where the Texture of the Body is so close and tenacious that the Spirit can find no Pores or Passages, at which to issue ; here also, in its Endeavour to get out, it drives the grosser Parts of the Body before it, and thrusts them above the Surface : which is the Case in the rusting of Metals, and the Corruption of all fat Bodies.

(6.) The

^b What this internal Spirit is, See below Sect. XL.

(6.) The third Action is somewhat obscure, but no less certain than the others, being a Contraction of the grosser Parts, after the Spirit is discharged. And, *first*, we see that Bodies manifestly shrink, and possess less Space, after the Exit of the Spirit; as we find in Nut-kernels, which when dried do not fill the Shell: and again, in Boarding and Paling, where the several Planks, or pieces of Wood, are laid close together at first; but gape and shrink from each other when dried. In like manner Bowls, and other Wood-work, crack and split with Dryness; whilst the Parts contract themselves, and thus of necessity leave empty Spaces between. *Secondly*, This appears from the wrinkling of dry Bodies; the endeavour of contracting themselves being so forcible as to bring the Parts together, and raise them up; for whatever is contracted in the Extremities must rise up in the middle, as we see in Paper, Parchment, the Skins of Animals, and in the Coat of soft Cheese: all which grow wrinkled with Age. *Thirdly*, This Contraction appears still more remarkably in such things as do not only wrinkle, but twist, curl up, and roll themselves round with Heat; as Parchment, Paper, and Leaves do when exposed to the Fire: for Contraction, through Age, proceeding but slowly, generally produces Wrinkles; whilst Contraction by the Fire, being sudden, causes curling. But in many Bodies where neither wrinkling nor curling can happen, there ensues a bare Contraction, Shrinking, Hardness, and Dryness, as we first observed. But if the Spirit be so far exhaled, and the Moisture so far consumed, as not to leave enough of the Body to unite and contract itself, then all Contraction necessarily ceases; the Body becomes rotten, and no more than a heap of Dust, clinging together, which is dissipated by a slight Touch, or thrown off into the Air; as we see in all Bodies greatly consumed; *viz.* Paper and Linen, burnt to the utmost; and in dead Bodies embalmed after lying many Ages.

(7.) It must be observed that Fire and Heat only dry by accident; for 'tis their proper Office to attenuate and dilate the Spirit and the Moisture: but it follows by Accident, that the other Parts contract themselves, either to prevent a *Vacuum*, as the vulgar Phrase is; or by the concurrent Action of some other Motion, about which we are not now enquiring.

(8.) 'Tis certain that Putrefaction, as well as Arefaction, has its Origin from the native Spirit; tho it proceeds in a very different way: for, in Putrefaction, the Spirit not being simply discharged, but in part detained, has strange Operations and Effects; whilst the grosser Parts also suffer, not a local Contraction, so much as a joint and homogenous Union.

SECT.

• See the Article *Putrefaction*, in the *Sylva Sylvarum*.

S E C T. IV.

*The History of the LENGTH and SHORTNESS of
LIFE in ANIMALS; pursuant to the third Article
of the Table of Enquiry.*

Preparation.

WITH regard to the Length and Shortness of Life in Animals, the Information procurable is but slender, Observation slight, and Tradition fabulous. Tame Creatures are corrupted by a degenerate Life; and wild ones intercepted by the inclemency of the Weather. Neither do the things which may seem concomitant assist us much in this Enquiry; as the bulk of the Body, the period of Gestation, the number of Young, the time of Growth, &c. these being complicated Considerations, that sometimes concur and sometimes not.

*The Age of
Man.*

1. The Age of Man, so far as can be collected from certain History, exceeds that of all other Animals, excepting a very few; and the Concomitants in him are found tolerably equable: his Size and Stature large, his period of Gestation nine Months, his Offspring generally single, his time of Puberty at fourteen, and his Growth reaching to twenty Years.

*Of the Ele-
phant.*

2. The Elephant certainly exceeds the ordinary Age of Man; their period of Gestation is not ten but two Years, or at least above one; their Bulk vast; their Growth till thirty; their Teeth exceeding strong: their Blood is observed to be the coldest of all Animals; and they sometimes live two hundred Years*.

The Lion.

3. Lions are thought to be long lived, because many of them have been found toothless; but this is no certain Sign, as it may proceed from their corrupt Breath, or other Cause.

The Bear.

4. The Bear is a great Sleeper, and a sluggish indolent Creature, yet not observed to be long lived; they should rather seem to be short lived, from their very short period of Gestation, scarce reaching to forty Days.

The Fox.

5. The Fox seems well provided for long Life; as being well covered, carnivorous, and living under Ground; yet he is not observed to be long lived: doubtless he is of the Dog-kind, which is but short lived.

The Camel.

6. The Camel is long lived; a lean sinewy Creature, that commonly reaches to fifty, and sometimes to a hundred.

The Horse.

7. The Horse shares a middle Life, scarce attaining to forty, and usually not to more than twenty; but this shortness of Life he probably owes to Man: for the Breed of the Sun is now no more, that ranged at large in fresh Pasture; yet the Horse continues growing till six, and generates in old Age. The Mare also goes longer with Young than the Woman; and but seldom foals double. The Ass has nearly the same Age as the Horse: But the Mule is longer lived than either.

8. The

* See the Account of Elephants in the *Philosophical Transactions*.

8. The Stag is vulgarly famed for long Life ; but upon no certain History. *Deer.* There goes a Report of a certain Stag found with a Chain about his Neck, buried in Fat. That he should be a long lived Creature seems less probable, because he comes to his full Growth at five ; soon after which his Horns, which are yearly shed and renewed, grow from a narrower Basis, and less branching.

9. The Dog is a short lived Creature, that lasts not above twenty Years ; *The Dog.* and seldom sees fourteen : he is hot, and lives unequally ; as being often in violent Motion, and often sleeping. The Bitch has many young ones at a Litter ; and goes with them nine Weeks.

10. The Bull or Ox is very short lived for his Size and Strength, scarce *The Ox.* exceeding sixteen Years ; tho somewhat more lasting than the Cow. She has seldom more than one Calf at once ; and goes about six Months. This is a sluggish and fleshy Creature, that easily grows fat, and feeds wholly upon Herbage.

11. Sheep seldom live to ten, tho a Creature of a moderate Size, and *The Sheep.* well covered ; and tho sharing but a very small proportion of Gall, yet their Coat is exceedingly curled, beyond that of any other Animal. The Ram generates not till the third Year ; and continues fit for Generation to the eighth. The Ewe continues to bear as long as she lives. 'Tis a Creature subject to Diseases, and seldom lives out its full course.

12. The Goat approaches the Sheep in Age, and almost every thing else ; *The Goat.* tho a more nimble Creature, and of a somewhat firmer Flesh ; whence he should seem longer lived : but he is much more salacious, and therefore shorter lived.

13. The Hog sometimes lives to fifteen or even twenty ; and tho its *The Hog.* Flesh be the moistest of all Animals, yet this seems to contribute nothing to the Prolongation of Life. But for the wild Boar, there is no certain account of him.

14. The Age of the Cat terminates between six and ten : a nimble *The Cat.* Creature, abounding in Spirit, that eats voraciously, and swallows without much chewing.

15. The Hare and Rabbet scarce last seven Years : they are both great *The Hare.* Breeders, and have many young at once. They differ in this, that the Rabbet lives under Ground, and the Hare above ; and, that the Flesh of the Hare is the darkest.

16. Birds fall far short of Quadrupedes in bulk of Body : an Eagle, or *Birds.* a Swan, being but little things compared to an Ox, or a Horse ; or an Ostrich compared to an Elephant.

17. Birds are well covered ; for Feathers exceed Wooll and Hair in point of Warmth, and sitting close to the Body.

18. Tho Birds have many young at once, yet they go not with them together, but lay their Eggs at several times ; whence the Chick receives a more copious Nourishment.

19. Birds masticate but little, if at all ; whence their Aliment is often found whole in their Crop ; yet they will break the Shell of a Nut, and pick out the Kernel.

20. The

The HISTORY of LIFE and DEATH.

20. The Flight of Birds is a mix'd Motion, compounded of the Motion of the Limbs and that of Carriage ; which makes a very wholsome kind of Exercise.

21. 'Tis well observed by *Aristotle*, as to the Production of Birds, that the Male Seed contributes little to their Generation ; but supplies rather Activity than Matter : whence an Egg productive of a Chick is, in many respects, undistinguishable from one that is not.

22. Most Birds come to their full Growth the first Year, or soon after : their Age is reckoned by the Feathers in some, and by the Beak in others ; but not by the magnitude of their Bodies.

The Eagle.

23. The Eagle is accounted long lived ; tho its Years are not observed. And 'tis esteemed a sign of his long Life, that he casts his Beak, and thence grows young again : whence the Proverb *Aquilæ Senectus*. But perhaps 'tis not the Renovation of the Eagle that casts the Beak, but the Change of the Beak that renews the Eagle ; for when the Beak grows too hooked, the Eagle must feed with difficulty.

*The Vulture.
The Kite.*

24. The Vulture is also said to be long lived ; so as to last a hundred Years. The Kite likewise, and all carnivorous Birds, and Birds of Prey, live long. But for the Hawk, as she lives a degenerate and servile Life under the Faulconer, no true Estimate can be made of the natural Period of her Duration : but the tame Hawk has been sometimes observed to live thirty Years, and the wild one forty.

The Raven.

25. The Raven likewise is said to live long, sometimes to a hundred ; a carnivorous Bird, not much upon the Wing ; but rather sedentary, and having very black Flesh. But the Crow, which resembles the Raven, except in Size and Voice, is somewhat shorter lived.

The Swan.

26. The Swan is certainly found to be a very long lived Creature, and often reaches to above a hundred : a Bird excellently plumed, that feeds on Fish, and delights in running Waters.

The Goose.

27. The Goose also is a long liver, but particularly the wild one ; tho a Creature that feeds on Herbage ; whence the *German Proverb* : *older than a wild Goose*.

The Stork.

28. Storks must needs be long lived, if the ancient Observation of them be just, that they never came to *Thebes*, because the City was often taken : for, if this were true, they must have had the Memory of more than one Age, or else the old ones must have taught the young ones History : but Fables are endless.

The Phoenix.

29. And so much is Fable interwove with the History of the Phoenix, as quite to bury the Truth, if there were any in it ; tho there is no great Wonder at what they anciently wonder'd at ; viz. that this Bird should be alway seen flying with a great Attendance of others : for we see the same thing happen to an Owl flying by day ; or to a Parrot that has quitted the Cage.

The Parrot.

30. A Parrot has certainly been known to live sixty Years in *England* ; but how old he was when brought over is uncertain : a Bird that feeds promiscuously,

miscuouſly, that maſticates his Meat, and caſts the Beak ; being likewiſe bold, ſtubborn, and black of Fleſh.

31. A Peacock lives to twenty ; but has not his *Argus* Eyes till three Years *The Peacock.* old : a Bird of ſtately Step, and whitish Fleſh.

32. The Dung-hill Cock is a ſalacious, martial, ſhort-lived Bird ; exceeding brisk, and white of Fleſh. *The Cock.*

33. The Turkey Cock ſomewhat out-lives the Dung-hill Cock : an iracund Bird, and of very white Fleſh. *The Turkey.*

34. The Ring-dove is a long liver, and ſometimes laſts till fifty : a Bird of the Air, that ſits and builds high ; but Doves and Turtles are ſhort lived, and ſcarce exceed eight Years. *The Ring-dove.*

35. Pheafants and Partridges may live to ſixteen Years ; being great Breeders, but of more duſky Fleſh than the Pullet kind. *The Pheasant.*

36. The Black-bird is ſaid to be the longeſt lived of all ſmall Birds : a bold Bird, and loud of Voice. *The Black-bird.*

37. The Sparrow is obſerved to be very ſhort lived ; which is attributed to Salacity in the Cock : but the Linnet, a Bird no bigger in Body, is obſerved to live twenty Years. *The Sparrow.*

38. Of the Eſtrich we have no certain account ; thoſe bred amongſt us have not been found to live long : and as to the Ibis, ſhe is only recorded for a long liver, without mentioning her time. *The Eſtrich.*

39. The Lives of Fiſh are known with more uncertainty than thoſe of Land Animals ; as being leſs obſerved on account of their living under Water : moſt of them are without Reſpiration ; whence their vital Spirit is more pent in ; and therefore, tho they reſreſh themſelves by their Gills, yet that kind of cooling is not ſo conſtant as by breathing. *Fiſh.*

40. As they live in Water, they eſcape the dryneſs and depredation cauſed by the external Air ; but, no doubt, the ſurrounding Water which enters, and is received into the Pores of their Bodies, proves more prejudicial than Air.

41. Their Blood is ſaid to have very little Heat ; ſome of them are very voracious, and prey even upon their own Species : their Fleſh is ſofter, and leſs tenacious than of Land-Animals ; but they fatten in an extraordinary manner, ſo that an incredible Quantity of Oil is afforded by the Whale Kind.

42. Dolphins are reported to live about thirty Years ; the Experiment having been tried by cutting off the Tails of ſome of them : and they continue growing till ten. *The Dolphin.*

43. They report a ſtrange thing of ſome Fiſh ; that after a certain Age their Bodies waſte greatly, while their Heads and Tails remain of the former Size.

44. The *Muræna* was obſerved, in *Cæſar's* Fiſh-ponds, to live ſixty Years ; and by long Uſe this kind of Fiſh was made ſo tame, that *Craſſus* the Orator bewail'd the Loſs of one of them. *The Muræna.*

45. The Pike is found much the longeſt Liver of all freſh-Water Fiſh ; ſometimes continuing for forty Years : a voracious Fiſh of prey, whoſe Fleſh is firm and dry. *The Pike.*

- The Carp.* 46. But the Carp, the Bream, the Tench, the Eel, &c. are not thought to live above ten Years.
- The Salmon.* 47. The Salmon is quick of Growth, but short-lived ; so is the Trout : but the Perch grows slow, and lives longer.
- The Whale.* 48. As to the Life of Whales, and the like Fish of vast bulk, we have no certain account ; nor of the Sea-calf, the Sea-hog, and innumerable other Kinds of Fish.
- The Crocodile.* 49. The Crocodile is reported to be very long lived, and also to have an extraordinary period of Growth ; insomuch that this is held the only Animal which grows as long as it lives. 'Tis an oviparous Creature, voracious, cruel, and well defended against the Water. But for any kind of Shell-fish, we find no certain account of their length of life †.

Larger OBSERVATIONS.

'Tis difficult to discover any Rule of the Length and Shortness of Life in Animals ; as well through a Neglect of Observations, as the Complications of Causes.

(1.) There are more Birds than Quadrupedes found to be long lived ; as the Eagle, the Vulture, the Kite, &c. tho they attain their full Growth in one Year, and are less of Body. Doubtless their Plumage is an excellent Covering against the Inclemency of the Seasons ; and as they chiefly live in the free Air, they are like the Inhabitants of clear Mountains, who prove long lived. Their Motion also, in their Flight, is less fatiguing, less shaking, and more wholesome. Nor do the first Rudiments of Birds suffer any Compression, or want of Aliment in the *Uterus* of the Female. But the principal Reason seems to be, that Birds are rather formed of the Substance of the Female than the Male : whence their Spirit is not so hot and fretting.

(2.) It may well be supposed, that the Animals made more of the Substance of the Female than the Male, are longest lived ; and that such as are longest gone with, will participate more of the Substance of the Female than the Male, and are therefore longer lived : whence, in conformity with some Observations of our own, we judge, even among Men, that those Children which resemble the Mother live the longest ; and so again, the Children of old Men, begotten upon young Wives ; provided the Father was sound, or no way distempered.

(3.) The Beginnings of all things lie most open both to Injury and Assistance ; so that a less degree of Compression, and a larger supply of Nourishment to the *Fœtus* in the *Uterus*, must naturally conduce much to the prolongation of Life ; and this happens either when the Young is excluded at different times, as in Birds, which are oviparous ; or when the Birth is single, as in Animals that have only one Young at once.

(4.) A

† If it were essential to the present Enquiry, it might be possible to procure a somewhat more exact and particular Account of the several Creatures above-mentioned ; as also of several others omitted.

(4.) A long continuance in the *Uterus* contributes three ways to the prolongation of Life. First, as the *Fetus* hence receives more of the Substance of the Female. Secondly, as it comes forth more strengthned and confirmed. And thirdly, as it later feels the predatory force of the Air. It also signifies that the Periods of Nature are performed in greater Revolutions. And altho Lambs and Calves, which remain but about six Months in the *Uterus*, are short lived; yet this proceeds from other Causes.

(5.) Creatures that feed upon simple Herbage, are of short duration; but those that feed on Flesh, or Seeds, and Fruits, as Birds, are of a longer; for, even Deer, derive one half of their Food from above their Heads: and the Goose, besides Grass, finds something in the Stubble-fields, and the Water.

(6.) We judge, that the covering of the Body greatly conduces to prolong Life; for this wards off, and prevents those unfriendly Assaults of the Air which, otherwise, strangely undermine and destroy the Body: and Birds are thus admirably fenced by their Plumage. But that Sheep, which are also well covered, are of short duration, must be imputed to the Diseases whereto that Creature is liable; and to their feeding chiefly upon Grass.

(7.) The Head is, doubtless, the principal Seat of the Spirits; and tho this be vulgarly said only of the animal Spirits, yet it holds equally of them all: and no question but the Spirits greatly prey upon, and consume the Body, so that both a greater quantity, or a greater acrimony and sharpness thereof must greatly shorten Life: whence we judge it a principal Cause of Longevity in Birds, that they have such little Heads in proportion to their Bodies; and conjecture, that such Men as have large Skulls are shorter lived than others.

(8.) The motion of Carriage we judge to excel all others for the prolonging of Life; now all Water-fowl, as the Swan, &c. have this Motion; so have all Birds in their Flight, tho every now and then mixed and compounded with a brisk motion of the Limbs: so again have Fish; tho as to the length of their Life we have no certainty.

(9.) The Creatures perfected slowest are most lasting; for this shews that Nature finishes her Periods by greater Revolutions; which holds not only of Growth, but of other degrees of Maturity: so Man first puts forth Teeth, afterwards the signs of Puberty, then the Beard, &c.

(10.) The timorous Animals are not long lived; as the Sheep, the Pigeon, &c. for the Bile is the Spur to many Functions in the Body.

(11.) The Creatures whose Flesh is dark-coloured, are longer lived than those whose Flesh is white; as indicating the Juices of the Body to be more compact, and less dissipable.

(12.) In all corruptible Bodies, Quantity has a great tendency to the preservation of the whole; a great Fire is not soon quenched; a small quantity of Water is soon evaporated; a Branch withers faster than the Trunk of a Tree; and therefore, in general, as to Species, tho not to Individuals, the

larger Animals are longer lived than the smaller, unless some other powerful Cause intervene^g.

S E C T. V.

The History of ALIMENTATION, and the Process of NUTRITION: with regard to the Fourth Article of the Table of Enquiry.

Aliment to be of a lower nature than the Body nourished.

1. ALL Aliment should be of an inferior Nature, and a more simple Substance than the Body intended to be nourished: Plants are fed by Earth and Water, Animals by Plants, and Men by Animals. There are also other carnivorous Creatures; and Man himself makes Plants a part of his Food: but Men, and other carnivorous Animals, are difficultly nourished by Plants alone; tho perhaps they might, by long use, with Fruits and Seeds that had felt the Fire; but not by Leaves or Herbage; as the Order of the *Folietani* experienced.

Shewn in Vegetables, living Creatures, and Men.

2. But too near an approximation, or similarity of Substance betwixt the Aliment and the Body to be nourished succeeds ill; for Creatures that feed on Herbage, touch no Flesh: few carnivorous Animals eat the Flesh of their own Species; and Canibals themselves do not ordinarily feed upon human Flesh, but either fall into this Appetite thro' depraved Custom, or a desire of revenging themselves upon their Enemies. A Field is not sown to advantage with the Grain itself yielded; nor a Tree successfully engrafted with its own Shoot.

Nutrition requires a Preparation of the Aliment.

3. The better the Aliment is prepared, and brought somewhat nearer in likeness with the Substance to be repaired, the better Vegetables thrive, and Animals fatten: for a Shoot planted in the Earth is not fed so well as when grafted on a Stock agreeable to its Nature; where it finds its Nourishment ready digested and prepared. And it has been lately discovered, that the Slips of wild Trees; as of the Elm, the Oak, the Ash, &c. yield a much larger Foliage by Incision, than without it. Men also are not so well nourished with raw Flesh, as with that prepared by Fire.

How Plants, and Animals, are nourished.

4. Animals receive their Nourishment by the Mouth, Vegetables by the Root; and the *Fetus* in the Mother, by the umbilical Cord: but Birds, for a time, are nourished by the Yolk of the Egg; some part whereof is found in their Craw after they are hatch'd.

The motion of the Aliment.

5. All Aliment moves principally from the Centre to the Circumference, or from within, outwards; only Trees and Plants are rather nourished by the Bark, and external Parts, than by the Pith, and internal: for if but a narrow

^g These Observations are a kind of deep physical Corollaries, sagaciously drawn from the preceding Facts, or History of Nature; and should be understood as so many first Attempts at a just Interpretation of Nature, with regard to the present Subject.

narrow Slip of the Bark be peeled off all round the Trunk, the Tree dies^a: and the Blood in the Veins of Animals nourishes the Flesh situated below as well as above them.

6. There are two Actions in all Alimentation; viz. Extrusion and Attraction; the former whereof proceeds from an internal, and the latter from an external Powerⁱ. *Two Actions in Alimentation.*

7. Vegetables assimilate their Nutriment simply, without Excretion; for Gums and the Tears of Trees are rather Redundancies than Excrements; and Fungus's are Diseases: but the Substance of Animals has a greater Perception of its like, and is therefore endowed with a Principle of Rejection; whereby it refuses the useless, and assimilates the useful Parts^k. *The Difference betwixt the Assimilation of Vegetables and Animals.*

8. 'Tis a remarkable thing in the Stalk of Fruit, that all the Nutriment, which sometimes produces such large Masses, should be compelled to pass thro' so slender a Neck; for Fruits never adhere to the Trunk or Branches without some Stalk between. *Nutriments pass thro' a slender Neck in Fruits.*

9. 'Tis observable that animal Seed is incapable of Nutrition, unless it be fresh; whilst the Seeds of Vegetables remain nourishable for a long time. Shoots however will not grow, unless grafted fresh and green; nor will Roots themselves long preserve their vegetative Power, unless covered over with Earth. *The seminal Power more lasting in Plants than Animals.*

10. The degrees of Nutrition in Animals differ with their Age; the *Fœtus* is first nourished by the Juices of the Mother; with Milk, after the Birth; next with Meats and Drinks; and in old Age, the grosser and higher relished Foods are generally the most agreeable. *The degrees of Nutrition differ with the Age.*

11. It has a capital tendency to the present Enquiry, with diligence and attention to discover, whether Nutrition may not be performed from without; at least otherwise than by the Mouth. Baths of Milk are used in Consumptions, and emaciating Diseases; and some Physicians judge a degree of Nutrition procurable by Glysters. Let this be examined to the bottom: for if Nutrition could be secured by Externals, or otherwise than by the Stomach; then the weakness of Digestion which attends old age, might be compensated by such Helps; and a Renovation be thus procured^l. *A Precept for farther Enquiry.*

S E C T.

^a Perhaps this is not confirmed.

ⁱ As in the Action of the absorbent Vessels, and excretory Ducts.

^k What is properly meant by this perceptive Principle, may appear from the *De Augmentis Scientiar.* Sect. X. p. 112.

^l This Enquiry seems not hitherto sufficiently prosecuted, to determine with certainty, how far Nutrition is procurable by Glysters, Unguents, Baths, impregnated Air, &c. Something however we find casually effected in this Way; but the thing requires an express Set of Experiments to measure its Force, and reduce it to Rule.

S E C T. VI.

The History of the Length and Shortness of LIFE in MAN ; with respect to the fifth, sixth, seventh, eighth, ninth, and eleventh Articles of the Table of Enquiry.

Particular Instances of long life in the Antediluvians.

Postdiluvians.

'Abraham:

Isaac.

Jacob.

Ishmael.

Sarah.

Joseph,

Levi.

Moses:

Aaron.

Phineas.

Joshua.

Ehud.

1. **T**HE Scripture relates that, before the Flood, Men lived to several hundreds of Years ; tho none of the Antediluvians arrived to a thousand. This Longevity cannot be attributed to Grace, or the sacred Lineage ; because there are reckoned, before the *Deluge*, eleven Generations, and but eight Generations of the Sons of *Adam* by *Cain* ; so that the Posterity of *Cain* seems to have been longest lived. This great age however was, immediately after the Flood, reduced to an half ; tho only in such as were born posterior to the Flood : for *Noah*, who was born prior to it, arrived at the age of his Fathers ; and *Shem* lived to six hundred Years. But three Generations after the Deluge, the Life of Man was reduced to about a fourth of the primitive Standard ; that is, to about two hundred Years.

2. *Abraham* lived a hundred and seventy-five Years ; a courageous and prosperous Man. *Isaac* lived to a hundred and eighty ; a Man of Peace and Chastity. And *Jacob*, a Man of Troubles and a numerous Offspring, held out to a hundred and forty ; being patient, mild and subtle. *Ishmael*, a military Man, lived a hundred and thirty Years. *Sarah*, the only Woman whose age is mentioned, lived to a hundred and twenty-seven ; a Woman of Beauty and Resolution ; an excellent Mother and Wife ; no less famous for her Frankness than her Duty to her Husband. *Joseph*, a prudent and politick Man, who suffered Affliction in his youth, but afterwards saw great Felicity, lived to a hundred and ten Years. His elder Brother *Levi*, lived to a hundred and thirty-seven ; a revengeful Man and impatient of Injuries. The Son of *Levi* also arrived at nearly the same age ; so did his Grandson, the Father of *Moses* and *Aaron*.

3. *Moses* lived a hundred and twenty Years ; a Man of Courage, tho of great Meekness, and slow of Speech. Yet *Moses* himself, in his Psalm, declares the Life of Man to be but seventy Years, and the halest Constitution but eighty ; which standard seems, in great measure, to have been observed to the present time. *Aaron*, who was three Years older, died the same year as his Brother ; a Man of ready Speech, easy Behaviour, and somewhat variable. But *Phineas*, Grandson to *Aaron*, is computed to have lived three hundred Years ; if the *Israelitish* War against the Tribe of *Benjamin*, in which Expedition *Phineas* was consulted, happened in the order of Time the History relates it : he was a Man exceedingly zealous. *Joshua*, a military Man, a great Leader, and always successful, lived a hundred and ten Years. *Caleb* was his Contemporary ; and seems his Equal in age. *Ehud* the Judge, seems at least to have been a hundred ; as after the Victory over the

Moabites,

Moabites, the Holy-Land had eighty years rest under his Government: he was a bold and daring Man; devoting himself to the Service of his People.

4. *Job* after being restored to his Felicity, lived a hundred and forty years; and had before his Affliction Children at Man's estate: he was a political, eloquent, and beneficent Man, and an Example of Patience. *Eli* the Priest, lived ninety eight years; a corpulent Man, of an easy Temper, and indulgent to his Children. *Elisba* the Prophet, seems to have lived to more than a hundred; as continuing sixty years after the Assumption of *Elias*; yet at the time of that Assumption, the Boys mock'd him by the name of old Bald-head: he was a vehement Man, severe, of an austere Life, and a despiser of Riches. *Esaiah* the Prophet, seems to have been a hundred, for he is found to have prophesied thro' the Course of seventy years; but the time he began to prophesy, and the time he died are both uncertain: He was a Man of great Eloquence, prophesied of the Gospel, and was full of the Promises of God as to the new Covenant.

5. *Tobias* the elder, lived a hundred and fifty eight years, and the younger a hundred and twenty seven; both merciful Men, and charitable. In the time of the Captivity, many of the Jews who returned from *Babylon* seem'd to have been long lived; as they are said to have remembred and bewailed the difference of the two Temples, at the distance of seventy years. Many Ages after this, in the time of our Saviour, we find *Simeon*, a Man of ninety, full of Religion, Hope and Expectation. At the same time, *Anna* the Prophetess is found to have lived to above an hundred; as having been married seven years, and a Widow for eighty four; whereto must be added the years of her Virgin state; and those she lived after her Prophecy of our Saviour: she was a holy Woman, that spent her Days in Prayer and Fasting.

6. The Accounts we have of the Longevity of Men in Heathen Authors are little to be depended on; both because of the Fables into which Relations of this kind are very apt to run, and the Fallacies of Calculation. The accounts extant afford nothing remarkable of the *Egyptians*, as to the point of long Life; for their Kings who reigned the longest, exceeded not fifty or fifty five Years; which is no great matter, as we sometimes find the same in later days. But the Kings of *Arcadia* are fabled to have been exceedingly long lived: indeed the Country was Mountainous, full of Flocks and Herds, and productive of wholesome Nourishment; but as it had *Pan* for its tutelar God, so all the Things related of it, seem to have been but panical, idle, and fabulous.

7. *Numa*, King of the *Romans*, lived to eighty; a peaceable contemplative Man, addicted to Religion. *Marcus Valerius Corvinus* lived to an hundred, there being forty six years between his first and sixth Consulship; a Man of great Valour, and Courage, courteous, popular, and always fortunate.

8. *Solon* the Legislator of *Athens*, and one of the seven Wise-men, lived to above eighty; a Man of Spirit, yet Popular, and a lover of his Country: he was also learned, yet no stranger to Pleasure, and a soft Life.

Epimenides. *nides* of *Crete*, is reported to have lived a hundred and fifty-seven years ; tho the Relation has somewhat of the Prodigy : for he is said to have pass'd, or slept away fifty-seven of them in a Cave. Half an Age after this, *Xenophanes* the *Colophonian* lived a hundred and two years, or more ; for at the Age of twenty-five, he left his native Country, and travell'd abroad seventy seven years complete ; then returned : but how long he lived afterwards is not certain. He was a Man as wandring in Mind as Body, insomuch that his Name, by reason of his wild Opinions, was changed from *Xenophanes* to *Xenomanes* ; tho doubtless a Man of a vast Imagination, and breathing nothing but Infinity.

Anacreon. 9. *Anacreon*, the Poet, lived to above eighty ; an amorous, voluptuary Man, and given to Wine. *Pindar* of *Thebes* likewise lived to eighty ; a sublime Poet, of a singular Genius, and a great Worshipper of the Gods. *Sophocles*. *Sophocles* of *Athens* arrived to the same Age ; a lofty Tragick Poet, wholly given to Writing, regardless of his Family-Affairs.

Artaxerxes. 10. *Artaxerxes*, King of *Persia*, lived ninety-four years ; a Man of little Genius, impatient of weighty Affairs, a lover of Glory, but a greater lover of Ease. At the same time, *Agefilaus*, King of *Sparta*, lived eighty-four years a moderate Man, and a Philosopher among Princes ; yet ambitious and a Warrior : tho no less effective in Business than in Battle.

Gorgias. 11. *Gorgias*, of *Sicily*, lived to a hundred and eight ; a Rhetorician, a boaster of his Knowledge, and one who taught for Profit : he was a great Traveller, and a little before his Death declared he had no Accusation to bring against old Age. *Protagoras*, of *Abdera*, lived ninety years ; he likewise was a Rhetorician, but profess'd not Arts and Sciences so much as Civil and Political Matters ; being a great Traveller as well as *Gorgias*. *Isocrates* of *Athens*, lived to ninety-eight : he too was a Rhetorician, tho a very modest Man, that appeared not in publick, but had his School at Home. *Democritus*.

Democritus. of *Abdera*, lived to a hundred and nine ; a great Philosopher, and of all the *Greeks* the best skill'd in Physicks, or natural Philosophy ; a great Traveller of Countries, but a greater still in the Works of Nature : he was a diligent Experimenter ; and pursued Analogy, rather than observed the Laws of Disputation. *Diogenes*, of *Sinope*, lived ninety years ; a Man who used great Liberty towards others, and tyrannized over himself, chusing a sordid Diet, and practising Patience. *Zeno*, of *Citium*, lived to ninety-eight ; a Man of lofty Thoughts, great Subtilty, and a despiser of Opinions ; yet not troublesome, but rather caught the Mind than bound it, in the manner of *Seneca* after him. *Plato*, of *Athens*, lived to eighty-one ; a Person of Courage, but a lover of Quiet ; sublime of Thought and speculative ; a polite well-bred Man, tho rather agreeable and majestic than chearful. *Theophrastus*, of *Eresus*, lived to eighty-five ; a Man of graceful Eloquence, and a grateful variety of Matter, who collected all that was pleasing out of Philosophy, without meddling with what was troublesome or disagreeable. *Carneades*, of *Cyrene*, a long time after, also lived to eighty-five ; a Man of a ready Eloquence, who delighted both himself and others with a pleasant and agreeable variety of Thought. In *Cicero's* Time, *Orbilius* the

Orbilius. 1

Grammatician lived to near an hundred, having been first a Soldier, then a Schoolmaster ; a sharp and austere Man, both with his Tongue and Pen, and no less severe to his Scholars.

12. *Quintus Fabius Maximus*, continued Augur sixty three years ; whence he must needs have lived to above eighty ; tho in the Augurship, Nobility was more regarded than Age. He was a prudent slow Man, moderate in all the parts of Life, and courteously severe. *Masiniſſa*, King of *Numidia*, lived ninety years, and had a Son after eighty five. He was a bold Man, that relied upon Fortune, and experienced many Vicissitudes of Affairs in his Youth ; but afterwards enjoy'd a continued run of Felicity. *Marcus Porcius Cato*, lived to above ninety ; a Man of a very hale Constitution, both in Body and Mind ; he was severe in Speech with his Tongue, delighted in Faction, took Pleasure in Agriculture, and was Physician to himself and Family.

Quintus Fabius Maximus.

Masiniſſa.

Porcius Cato.

13. *Terentia*, Wife to *Cicero*, lived to a hundred and three ; a Woman that struggled with many Calamities ; as first, the Banishment of her Husband, next the Difference between them, again with his final Misfortune, and with frequent Fits of the Gout. *Luceia* must have lived above a hundred years ; for she is said to have acted upon the Stage during a complete Century ; playing, perhaps, first the part of a Child, and at last that of a decrepid old Woman. *Galeria Copiola*, who was both a Player and a Dancer, was brought upon the Stage again, ninety nine years after her first appearance thereon ; not now indeed as an Actress, but as a wonder, at the Dedication of the Theatre by *Pompey* the Great ; and again also at the votive Solemnities for the Life of *Augustus*.

Terentia.

Lucela.

Galeria Copiola.

14. There was another Actress inferior to her in Age, but superior in Dignity, who lived almost to ninety, viz. *Livia Julia Augusta*, Wife to *Augustus Caesar*, and Mother to *Tiberius* : for if the Life of *Augustus* were a Play, as himself wou'd have it, and desired his Friends to clap him as he died ; doubtless *Livia* was an excellent Actress, who cou'd so well suit a dissembled Obedience to her Husband, with her Power and Authority to her Son. She was an affable, maternal, busy Lady, and tenacious of Power. *Junia*, Wife to *Caius Cassius*, and Sister to *Marcus Brutus*, lived also to ninety ; for she survived the Battle of *Philippi* sixty four years ; she was a Woman of Courage, happy in Wealth, but afflicted with the Calamity of her Husband, Relations, and a long Widowhood ; tho still honoured and regarded.

Livia.

Junia.

15. The seventy sixth year of our Saviour, happening in the time of *Vespasian*, is a remarkable Year, wherein we find a kind of Chronicle of long Lives ; for in this Year there was a Taxation, which is a Thing that affords the most authentick and just Information, as to the Ages of Men: and in that part of *Italy* which lies betwixt the *Appennines* and the *Po*, there were found a hundred and twenty four Men of a hundred years old and upwards ; viz. fifty four of a hundred, fifty seven of a hundred and ten, two of a hundred and twenty five, four of a hundred and thirty ; again, four of a hundred and thirty five, or thirty seven, and three of an hundred and forty years old. Besides these, *Parma* in particular afforded five ; three whereof were

The Taxation in Vespasian's Time.

each a hundred and twenty, and two a hundred and thirty years old; *Bruxella* afforded one of a hundred and twenty five; *Placentia*, one of a hundred and thirty one; *Faventia*, one Woman of a hundred and thirty two; and a Town then call'd *Velleiacium*, situate on the Hills about *Placentia*, afforded ten, six whereof were aged a hundred and ten, and four a hundred and twenty. Lastly, *Ariminum* afforded one aged a hundred and fifty, whose Name was *Marcus Aponius*.

Admonition.

16. To shorten this History, we have here produced, and shall go on to produce no Example of an Age under eighty. We affix to each Person, a very concise and just Character or Elogy, of the kind that, in our Judgment, has some relation to long Life, is not a little regulated by Men's Manners and Fortunes. This relation to Life is of two kinds; and intimates either that such Persons generally prove long lived; or that such, tho less disposed thereto, may yet sometimes live long.

*The Emperor
of Germany,
66.*

17. Among all the *Roman* and *Grecian* Emperors, together with those of *Gaul* and *Germany*, down to our own Age, containing a List of about two hundred Princes, there are found but four who arrived at the Age of eighty. To these may be added, the two first Emperors, *Augustus* and *Tiberius*; the latter whereof lived to seventy eight, and the former to seventy six; tho both of them perhaps might have lived to eighty, but for *Livia* and *Caius*.

Augustus.

Augustus, was a Man of a moderate Temper, tho earnest in the dispatch of Business; in other Respects, calm and serene; temperate in his Diet, but profuse in Venery, and happy in all Things. In the thirtieth Year of his Age, he suffered a severe and dangerous Illness, insomuch that his Life was despair'd of; but *Antonius Musa*, his Physician, when the rest had applied hot Remedies for the Distemper, cured him by the application of cold ones; which,

Tiberius.

perhaps, was of Service in prolonging this Emperor's Life. *Tiberius* was a Man of *slow Jaws*, as *Augustus* call'd him, being slow, tho powerful in Speech: he was cruel, a Drinker, and made Lust a part of his Regimen; yet took great care of his Health, and was used to call that Man a Fool, who after thirty consulted a Physician. *Gordianus* the elder, lived eighty years, and at last died a violent Death, before he was well seated in the Empire; a courageous, magnificent, learned Man, and a Poet; and till the time of his Death enjoy'd a constant Course of Happiness.

Gordianus.

Valerian.

The Emperor *Valerian* lived seventy six years, before he was taken Prisoner by *Sapor* King of *Persia*; after his Captivity he lived seven Years in the midst of Reproaches, and at length died a violent Death; a Man of an ordinary Capacity, effeminate, but lifted up by popular Breath, and failing in Performance. *Anastasi*, surnamed *Dicorus*, lived eighty eight Years; a Man of a peaceable Mind, but abject, superstitious and timorous.

Anastasi.

*Anicius Just-
inianus.*

Anicius Justinianus, lived eighty three years; a Man desirous of Glory, yet indolent in his own Person, but happy and eminent in the Conduct of his Leaders; he was uxorious, not his own Master, but led about by others. *Helena Bri-*

tanna.

tanna, the Mother of *Constantine* the Great, lived to eighty; a Woman that intermeddled little in civil Affairs, neither in the Reign of her Husband or Son, but given wholly to Religion; yet of a great Mind, and always happy.

Theodora

Theodora the Empress lived to above eighty; a Woman of Business, that delighted in governing: she was exceeding fortunate, and thence credulous.

18. To proceed from secular Princes, to the Heads of the Church. *St. John*. *St. John* the Apostle, and beloved Disciple, lived ninety three years, and is thence justly denoted by the Emblem of the Eagle, (breathing nothing but what is Divine, and appearing like a Seraph) among the Apostles, by reason of his fervent Charity. *St. Luke*. *St. Luke* the Evangelist lived eighty four years, an eloquent Man, and a Traveller; the inseparable Companion of *St. Paul*, and a Physician. *Simeon* the Son of *Cleophas*, call'd the Brother of our Lord, and Bishop of *Jerusalem*, lived an hundred and twenty years; and then too cut short by Martyrdom; he was a couragious and constant Man, full of good Works. *Polycarp* a Disciple of the Apostles, and Bishop of *Smyrna*, seems to have lived above a hundred years, tho taken off by Martyrdom; a Man of a great Soul, heroic Patience, and indefatigable Diligence. *Dionysius* the *Areopagite*, who was Contemporary with *St. Paul*, seems to have lived ninety years; he was call'd the Bird of Heaven, from the high flight of his Theology; and was as remarkable for Works as for Contemplation. *Aquila* and *Priscilla*, first the Entertainers, and afterwards the Assistants of *St. Paul*, lived together in happy and memorable Wedlock, to the Age of at least a hundred; for they were surviving under *Xystus* the First; a noble Pair, and of diffusive Charity. *St. Paul the Hermit*. *St. Paul the Hermit*, died at a hundred and thirteen: he lived in a Cave upon such simple and coarse Diet, as shou'd seem scarce able to support Life; he spent his whole time in Contemplation and Soliloquy; tho he was not illiterate but learned. *St. Anthony* the first Founder, or, as some say, the Restorer of the Order of Monks, lived to a hundred and five; a devout contemplative Man, yet versed in civil Affairs: his kind of Life was austere and hard, tho he lived in no inglorious Solitude, nor without some sway; having his Monks under him, and receiving the Visits and Homage of Christians and Philosophers. *St. Athanasius*. *St. Athanasius* lived to above eighty; a Man of invincible Constancy, and always triumphant over Fame; never yielding to Fortune: he was generous to those in Power, he kept in the good Graces of the People, and was a great Master in Party disputes, wherein he engaged with uncommon Heat and Vigour. *St. Jerom*. *St. Jerom*, according to the more general Opinion, lived to above ninety; a fine Writer, and of manly Eloquence; skill'd in the Sciences as well as Languages: he was also a Traveller, and lived austere in his old Age, bearing a great Spirit in private Life, and shining diffusively from Obscurity.

19. Two hundred and forty one Popes of *Rome* have now succeeded to the Chair; of which Number only five are found to have lived up to eighty years; but Martyrdom shorten'd the natural Lives of many of the primitive Bishops. *John* the twenty third Pope lived ninety years; a Man of a restless Spirit, studious of Novelties, and making many Innovations, some for the better, and many for Alteration's sake; amassing together great Wealth and Riches. *Gregory*, call'd the Twelfth, created Pope in Schism, and a kind of *Inter-regnum*, lived to ninety; but the Shortness of

his Papacy leaves us no more of his Character. *Paul* the Third, lived eighty one years ; a Man of a calm Mind and deep Knowledge : he was also learned, an Astrologer, and had a great Regard to his Health ; but was, like old *Eli*, over indulgent to his Family. *Paul* the Fourth, lived eighty three years ; a Man of a rough and austere Temper, of a high imperious Spirit, passionate, but eloquent, and ready of Speech. *Gregory* the Thirteenth also lived to eighty three ; a truly good Man, sound both in Mind and Body, political, temperate, full of good Works and Charity.

Miscellaneous
Instances of
Long-Life.

20. The *Essenes* among the *Jews* are commonly said to have lived above a hundred years ; a Sect that used a very simple Diet, according to the *Pythagorean* Rule. *Appollonius Tyanzus* lived more than a hundred years ; a Man for such an Age, of a graceful Aspect : he was doubtless a wonderful Person, and held by the Heathens for divine, but for a Magician by the Christians ; he was a *Pythagorean* in his Diet, a great Traveller, lived in Reputation, and was worship'd as a Deity ; but towards the close of his Life, he was accused and reviled, tho he still escaped safe to the last. His Grandfather also lived to a hundred and thirty. *Quintus Metellus* lived to above a hundred ; and after having happily gone thro' several Consulships, he was in his old Age made *Pontifex Maximus*, and officiated accordingly for two and twenty Years, without any faltering of the Voice, or trembling of the Hand. *Appius Cæcus* lived to a very great Age, tho his Years are not recorded ; the greater part whereof he pass'd in Blindness, tho without being dispirited ; but still manfully governing a numerous Family, a great Dependance, and the Commonwealth itself. In the Extremity of his Age he was brought to the Senate in a Litter, and was strenuously against the making Peace with *Pyrrius* ; and upon that occasion delivered his Speech, the beginning whereof is exceedingly remarkable, and shows an invincible Spirit and Strength. *Hiero*, King of *Sicily*, in the time of the second *Punick* War, lived almost to a hundred ; a Man moderate both in his Manners and Government, a Worshipper of the Gods, a religious Preserver of Friendship, beneficent, and always fortunate. *Hippocrates*, the famous Physician of *Cous*, lived to a hundred and four, and thereby approved and recommended his Art ; a Man of Prudence and Learning, attached to Experience and Observation ; not endeavouring at Words or Methods, but barely separating and laying down the Sinews of Science. *Afinius Pollio*, Friend of *Augustus*, lived a hundred Years ; a Man of great Luxury, but eloquent, and a Lover of Letters ; yet vehement, haughty, cruel, and seeming born wholly for himself. There goes a current Report of *Seneca*, that he lived to a hundred and fourteen, but this cannot be true ; for so far from being a decrepid old Man when promoted Governour to *Nero*, that he was then extremely fit for Business ; and but a little before that, in the Reign of *Claudius*, was banish'd for Adultery with certain Ladies of the first Rank ; a Crime not suitable to such an Age. Many of the *Venetians* are found to be long lived, even among their Nobles ; as the Duke *Franciscus Donatus Thomas Conterenus*, and *Franciscus Molinus*, both of them Procurators of *St. Mark* : but the most remarkable Instance is, that of *Cornaro* the *Venetian*, who being a Valetudinarian, at first began

to

to eat and drink by Weight and Measure, for the sake of his Health, which brought him by degrees to a certain Diet ; and this Diet to a very long Life, even that of a hundred Years and more, with the entire use of his Senses, and a constant course of Health. And in our Time, one *Postel* a French Man, lived almost to a hundred and twenty ; the extremity of his Beard, on the Upper-lip, growing dark, not at all grey : the Man was disordered in his Senses, a great Traveller, a Mathematician, and somewhat heretical .

20. Amongst us, in *England*, perhaps there is no populous Village wherein a Man or Woman of eighty may not be found. A few Years since, at a Wake in *Herefordshire*, there was a Dance performed by eight Men, whose Ages put together made up eight hundred Years ; for so much as some of them fell short of a hundred, others exceeded ².

21. In *Bethlem-hospital*, in *London*, destin'd to the Reception of Lunatics, there are found, from time to time, many distracted Persons long lived. And so much for the *History of Longevity* in Man, with regard to Individuals. We next proceed to *collective* or *general Observations*.

22. The Succession of Ages, and of the Generations of Men, seems no way to shorten the length of human Life ; since the Age of Man down from *Moses's* time to the present, has stood at about eighty years, without gradually declining, as one might have expected. But, doubtless, there are Times in every Country, when Men live to a longer or a shorter Term ; and they generally prove longest-lived, when the Times afford but a simple Diet, and give greater occasion to bodily Exercise ; and shortest-lived, when the Times are more polite, or abound in Luxury and Ease : but these Things have their Changes and Revolutions ; whilst the Succession of Mankind holds on, uninterrupted, in its Course. And, no question, but the Case is the same in other Animals ; as neither Oxen, Horses, Sheep, &c. have had their term of Life shorten'd in the latter Ages ; and therefore the Lives of Creatures, it should seem, were at once abridged by the Deluge. And the like may happen from other grand Accidents ; as particular Inundations, long continued Droughts, Earthquakes, &c. This Observation seems likewise to hold with regard to the Size or Stature of the Body, which alters not with the Succession of Generations ; tho' *Virgil*, following the common Opinion, predicted Posterity should diminish in their Size ². For tho, 'tis certain, there have antiently been Men of a gigantic Stature ; as appears from their Remains found in *Sicily* and elsewhere, in antique Sepulchres, Monuments, and Caverns ; yet there has no such thing been continued in the same Places for these three thousand Years, of which we have any authentick Account ³ : tho' this Matter likewise is subject to Revolutions and Changes, thro' the
Manners

² This History might be continued a Century lower, with an Account of many memorable Persons of both Sexes, who have lived to above fourscore, and some to above an hundred ; particularly such as old *Parr*, *Jenkins*, &c.

³ *Grandisq; effossis mirabitur ossa sepulchris.*

⁴ And possibly the Bones here mention'd might be the Bones of Elephants, not of Men.

General Observations with regard to Longevity.

Manners and civil Customs of Men, no less than the former. The more regard should be had to these Observations, because Men are ~~are~~ possess'd with a Notion, that the Age of the World is constantly upon the Decline, both as to the length of Life, and the size and strength of the Body; and that all things decay and tend to the worse.

The Inhabitants of the Northern Regions longer lived than the Southern.

23. In the cold Northern Countries Men generally live longer than in hot ones; which happens from hence, that the Skin of the Body is there more constringed, the Juices of the Body less dissipated, the Spirits themselves less sharp and predatory, or more easy to repair; and the Air, as being but little heated by the Sun, less consuming. Under the Equinoctial however, where they have a double Winter and a double Summer, and a greater Equality in the Spaces of Day and Night, they live to a considerable Age, if nothing else prevent it; as in *Peru, Ceylon, &c.*

24. The Inhabitants of Islands are generally longer lived than the Inhabitants of Continents; for the People of *Russia* live not so long as those of the *Orcades*; nor those of *Africa* under the same Parallel, as those of the *Canaries*: the *Japonesse* also, are longer lived than the *Chinese*, tho the latter are extravagantly fond of long Life. The Cause seems to be this, that the Sea-Breezes warm in cold Climates, and cool in the hot.

High Situations conducive to long Life.

25. Lofty Situations are more conducive to long Life than low ones; especially if not upon the tops of Mountains, but upon high Lands as to the Situation in general; such as *Arcadia* in *Greece*, and part of *Ætolia*; where the Inhabitants were very long lived. And the case would be the same in Mountains themselves, on account of their pure and clear Air, if not accidentally affected by the Vapours rising from the Vallies, and hanging about all Mountains. Whence the Inhabitants of snowy Mountains are not very long lived; as in the *Alps*, the *Pyreneans*, and the *Apennines*; but all middle sized Hills, and in Vallies also, Men are found to live longer. Again, on the tops of the Mountains running towards *Æthiopia* and the *Abyssines*, Men lived to a very great Age, and, at this day, often to a hundred and fifty; for here, by reason of the Sands at the bottom, little or no Vapour can rise up to the top of the Mountains.

Low Lands ill suited to Strangers.

26. Marshy, and fenny Lands, especially those lying upon a flat, suit better with the Natives than with Strangers, as to the prolonging, or shortning of Life: and what seems strange, the salt Marshes, which are, at certain seasons, overflowed with Sea-water, prove more unwholesome than the fresh.

The long lived Countries.

27. The particular Countries remarkable for long lived Inhabitants, are *Arcadia*; *Ætolia*; *India*, on this side the *Ganges*; *Brazil*; *Ceylon*; *Britain*; *Ireland*; the *Orcades*, and our *Western Islands*.

Wholesome Air how known.

28. The *Wholesomeness of the Air*, especially in a perfect degree, is a secret, and conceal'd thing; discoverable rather by Experiment than by Reasoning, and Conjecture. Trial hereof may be made, by exposing a Fleece of Wooll to the Air, for some Days; to see if it loses little of its Weight. Again; by observing if a piece of Flesh will continue long in the Air uncorrupted: And again; if the Weather-glass plays within a small compass.

pass. But of these, and the like Experiments, let farther Enquiry be made⁴.

29. Not only the Goodness, or Purity, but also the Equality of the Air, has regard to long Life. The intermixture of Hills and Vallies, tho' pleasing to the Sight and the Sense, may be held Suspect as to lengthning of Life; but a moderately dry Plain, neither too barren, nor totally without Trees and Shade, is better suited to procure Longevity.

The Equality of Air regards long Life.

30. Inequality of Air is prejudicial in a Mansion-place; but the Change of Air in travelling, after being accusom'd to it, is serviceable: whence many great Travellers have proved long lived. So likewise, such as dwell continually in the same little Cottage, without change of Place, are long lived; for that Air consumes less to which the Body is accusom'd; but change of Air nourishes and repairs more.

Inequality and Change of Air, where proper.

31. Tho' the Revolution and Number of Successions conduce nothing to the length, or shortness of Life, as we observed above; yet the immediate State of the Parent, both on the side of Father and Mother, must, doubtless, greatly regard it. Thus some beget Children when they are old, others when young; some at a proper age; some when unsound, and ill-disposed; some when morbid and languid; some when full, and in Liquor; some after Sleep, and in the Morning; some after a long intermission, or frequent repetition of the conjugal Act; some in the heat of a Love-fit, which is commonly the case of a spurious Issue; and some again, when the edge of Love is taken off, as after long Cohabitation. And the like Particulars hold also of the Mother; whereto may be added her State whilst she goes with Child, her Health and Diet, together with the Time, or Month, she goes to. 'Tis a difficult thing to reduce all this to Rule, with regard to Longevity; the more so, because what a Man might judge for the best, may happen to prove the worst: so that alacrity in Generation, which produces Children of a robust and active Body, may contribute less to lengthen Life, from the Acrimony and Inflammation of the Spirits attending it.

The Age of the Parents has an Influence on the Children.

32. We before observed, that a large Participation of the Mother's Juices contributes to the Longevity of the Child: in other Respects we judge moderate things the best; conjugal Affection, better than loose; the Morning better for Generation; the state of the Body, not over full, or vigorous, &c. It must also be well observed, that the robust habit of the Parents, makes better for themselves than for the Child, especially in the Mother. Plato therefore judged, unskillfully, that the power of Generation was defective, because the Woman did not use the same exercise of Mind and Body as the Man: for a difference of Powers, between the Male and Female, is of greatest service to the Child; whence Women, and Nurses, of a delicate and tender Constitution, supply the best and most plentiful Nourishment to the *Fetus*, and the Child. Nor were the Children of the *Spartan* Women, who married not before the age of Twenty-two, or, as others say, Twenty-five, finer, or longer lived, than those of the *Roman*, *Athenian*, or *Theban* Women,

The Particulars in Parents conducive to the long Life of Children.

⁴ See the Author's *Sylva Sylvarum*, under the Articles, AIR, PLAGUE, &c.

Women, who were marriageable at Twelve or Fourteen. And if the *Spartans* had any great Advantage, it was more owing to their sparing Diet, than to the late Marriage of their Women. Lastly, 'Tis manifest from Experience, that certain Races of Men are long lived for a Season; insomuch that Longevity, as well as Distempers, may be hereditary and periodical.

Prognosticks of long Life, from the Complexion. 33. Persons pale in the Face, Skin, and Hair, are not long lived; but such as are brown, red, or freckly, prove more lasting. Too fresh a Colour in Youth, is not so good a sign of long Life as Paleness. A hard Skin denotes a longer Life than a soft Skin: but this is not meant of a thick, or Goose-skin, which seems spongy; but of one that is both hard and close. So likewise a Forehead with large Wrinkles, is a better Sign than one that is smooth.

From the Hair. 34. Hard bristly Hair denotes a longer Life than such as is soft and weak; so likewise does curled Hair, especially if harsh, promise better than such as is soft and glossy: so again, does Hair, thick and short-curled, better than that in larger Rings.

From Baldness. 35. Baldness, coming early or late, is a thing indifferent; for numerous bald Men have proved long lived: and even Greyness, happening early, is fallacious; for many that were soon grey, have lived long after it; nay, to grow grey before the time, without growing bald, is a sign of long Life, tho' not, if attended with Baldness.

Hairiness on the Body. 36. Hairiness on the upper-part of the Body, is a sign of short life; and those extraordinary hairy on the Breast, are not long lived: but Hairiness on the lower-parts, as the Thighs and Legs, denotes Longevity.

The Size of the Body. 37. Tallness of Stature, if not excessive, and the Body be well set, but not thin, especially if attended with Agility, is a sign of long Life: as, on the other hand, Men of a short Stature, and slow of Motion, live not so long.

The Proportion of its Parts. 38. As to Proportion: They who are short in the Body, but long in the Legs, live longer than those who are tall in the Body, but short in the Legs. And again; those who are of a large Make below, but slender upwards, the Body thus rising as it were conical, are longer lived than those who are broad shoulder'd, and squeez'd in below.

The Habit of the Body. 39. Leanness, where the Passions are calm, and the Temper easy; and a full Habit, where the Passions prove more vehement; are signs of long Life: but Corpulency in Youth, denotes shortness of Life; tho' in Old Age it is a thing more indifferent.

Growth. 40. For Growth to continue long and gradual, is a sign of Longevity; and if it produce a large Stature, the Sign is great; but smaller, if a less: as, on the contrary, sudden Growth to a large Stature, is a bad Sign; but if to a short one, less bad.

Flushiness. 41. Firmness of Flesh, plump Muscles and Sinews, a smallness of Buttock, and a rising of the Veins, denote long Life; and the contrary, a short one.

The Make of the Head. 42. A small Head in proportion to the Body, a moderate Neck neither long nor scraggy, full, nor short, nor as it were buried in the Shoulders; wide

wide Nostrils, whatever be the form of the Nose; a large Mouth; an Ear gristly, not fleshy; Teeth strong, close join'd, not small, or thin set; all these are signs of long Life; and so much the more if any new Teeth shoot out in advanced Age.

43. A wide Chest, rather sunk in than prominent; round Shoulders; a *Chest.* flat Belly; a large Hand with but few Lines in the Palm; a short round Foot; a Thigh not over fleshy; and a firm Calf; are signs of long Life.

44. A large Eye, with the *Iris* greenish; the Senses not over quick; a *Eyes.* Pulse slow in Youth, but quicker as Age comes on; an ability of holding the Breath long; Costiveness in Youth; and Laxativeness in Age; are also signs of long Life.

45. There has been nothing remarkable observed of the times of Na- *Times of Na-* tivity with regard to long Life, except what is astrological; which is a Con- *tivity.* sideration we here meddle not with: tho it finds a place in our *Tables of Enquiry.* A Birth at eight Months end is so far from being long lived, that 'tis scarce thought capable of rearing. And Children born in the Winter, are accounted longest lived..

46. A *Pythagorean* or *Monastic* Diet and Life, led conformable to strict Rules, *Diet.* and always exactly equable, like that of *Cornaro*, seems a thing of great power in the prolongation of Life. On the contrary, of such as live freely, and in the common way, those are frequently found to live the longest that eat and drink to the full, or use a liberal Table. A moderate or temperate Diet is recommended, and indeed contributes to Health, but has little efficacy in prolonging Life; for the strict Regimen supplies few Spirits, and those sluggish; whence it consumes the less; whilst the full Diet affords a more copious Nourishment, and therefore recruits the more: but the moderate one does neither. Indeed where Extremes are hurtful middle Courses prove the best; but where Extremes are serviceable, Moderation is of little significance. The strict Regimen requires watching, otherwise the few Spirits may be oppress'd by much Sleep; it requires little Exercise to prevent their wasting; and an abstinence from Venery, lest they should be exhausted: but the full Diet suits best with full Sleep, frequent Exercise, and a seasonable use of Venery. Bathing and Anointing conduce more to pleasure than the prolongation of Life. But we shall speak more closely to all these Heads, when we come to enquire of *Intentions* * with a view to Practice. In the mean time, the Advice of *Celsus*, who was not only a Physician but also a learned and wise Man, should not be slighted, when he directs a Variety and Change of Regimen; tho still with the advantage to the more grateful side: for example, that a Man should sometimes accustom himself to watching, and sometimes indulge himself in Sleep, but ofteneft the latter: That he should sometimes fast, and sometimes eat freely, but ofteneft the latter: And, that sometimes he should strongly employ, and sometimes slacken the Faculties of his Mind; but ofteneft slacken them. Doubtless, a well regulated Diet has a principal Share in the prolongation of Life; nor have I

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* See hereafter, *Sett.* VIII.

ever yet met with a Man of any great Age, who did not, when he was asked, say he observed a certain Peculiarity in his Diet ; some one thing, others another. And I remember an old Man of above a hundred, produced as a Witness upon an antient Prescription, who, when he had given in his Evidence, being familiarly asked by the Judge, what Course he took to live so long ? unexpectedly replied, with the Laugh of the Audience, by eating before he was hungry ; and drinking before he was dry.

Course of Life.

47. A Life spent in religious Duties and Offices, seems conducive to Longevity. This kind of Life is attended with Ease, Admiration, the Contemplation of divine Matters ; noble Hopes, wholesome Fears, pleasing Melancholy ; continual Renewals by Observances, Penances and Expiations, without sensual Delights ; all which Conditions have a strong tendency to prolong Life. And if to these be added, the austere Diet, which indurates the Body ; and humbles the Spirit ; no wonder if it procures a remarkable Longevity : like that of *Paul* the Hermite ; *Simeon* the *Stylite*, or *Columnar* Anchorite ; with many other Anchorites and Hermites of the Desert.

Study.

48. What approaches nearest to the former, is a *Life of Letters* ; as that of Philosophers, Rhetoricians, Grammarians, &c. for this also turns upon Leisure, and such Thoughts, as, little regarding the Affairs of Life, have no Severity ; but delight by their Variety and Impertinence. Men of Letters also live to their own Wish, and bestow their time upon Subjects that please them best ; and are commonly in the company of Youth, which is more agreeable. But there is a great Difference betwixt Philosophies, as to prolonging Life, in respect of their Sects ; those being the best for this purpose which have somewhat of Superstition, and sublime Speculation ; as the *Pythagorean*, and *Platonic*. So likewise those which ranged the Universe, and took in all the Varieties of Nature, and had clear, noble, and lofty Thoughts (as of Infinity, the Stars, heroic Virtues, &c.) were conducive to long Life ; as the Philosophies of *Democritus*, *Philolaus*, *Xenophanes*, the Astrologers and the *Stoicks*. Those likewise were proper to this End, that without any deep Speculation, or severe Enquiry, but on the footing of common Sense, and vulgar Opinions, calmly disputed on both sides of the Question ; as those of *Carneades*, the *Academicks*, the antient Rhetoricians, and Grammarians. On the contrary, the dogmatical Philosophies, that turned upon perplexing Subtilties, and examined and wrested every thing in conformity to certain Principles ; and lastly, all the thorny and strait-laced Philosophies such as were generally those of the *Peripateticks* and the Schools, are bad for this purpose.

A Country Life.

49. A *Country Life* is also well suited to procure Longevity ; as being led much without doors in the open Air, not indolently but in action, and generally supported with fresh and unexpensive Diet, without Envy, without Care.

A Military Life.

50. We likewise entertain a good Opinion of a military Life in Youth. Many great Leaders have been long lived ; as *Corvinus*, *Camillus*, *Xenophon*, *Agésilas*, and others, both Antients and Moderns. 'Tis doubtless of service to long Life when all things, from Youth to Old Age, have a favourable and

and friendly Tendency ; so that a Youth inured to Hardships may alleviate and sweeten Old Age. We likewise judge that military Passions, on the watch for Battle and Victory, give such a warmth to the Spirits as conduces to Longevity ^f.

S E C T. VII.

Of REMEDIES conducing to Long LIFE : with regard to the tenth Article of the Table of Enquiry.

THE *Art of Medicine* at present in use, regards little more than the *Transiſion*. Preservation of Health, and the Cure of Diſeaſes ; without, or but tranſiently, taking notice of ſuch things as properly contribute to the prolongation of Life. We ſhall however, here lay down the Medicines in eſteem for this purpoſe ; which go by the Name of *Cardiacs* : for ſuch Remedies as in Cures defend and corroborate the Heart, or, more properly, the Spirits, againſt Poiſons and Diſeaſes ; being judiciously, and with choice, introduced into Diet, may very probably alſo conduce, in ſome meaſure, to prolong Life. And this we ſhall do, not in the common way by throwing ſuch Medicines in a promiſcuous Heap ; but by ſelecting out the moſt eminent.

1. *Gold* is exhibited in three Forms ; viz. that of *Aurum Potabile*, as 'tis called ; quenched in Wine ; and in Subſtance, as in Leaf or Filings. The *Aurum Potabile* began to be given in dangerous or inveterate Diſeaſes, as an excellent Cordial ; and with no deſpicable Succeſs : but we judge, that the Virtue is owing to the Spirit of Salt, which makes the Solution, rather than to the Gold itſelf ; tho' this be ſtudiouſly concealed. But if the Body of Gold could be opened without a corroſive Menſtrum, or by corroſive Menſtrums without any pernicious Quality ; provided the Solution were afterwards well waſhed, we judge it might be an uſeful thing. *A Table of Cordials. Gold.*

2. *Pearls* are taken either in Levigated Powder, or in a Magiſtery or Solution, made with the Juice of freſh and very tart Lemmons : they are likewiſe ſometimes given in aromatic Confections ; and ſometimes in a fluid Form. Doubtleſs the Pearl has ſome affinity with the Shell it adheres to ; and may have a like virtue with the Shells of Crawfiſh. *Pearls.*

3. Among the transparent Gems there are principally two accounted Cordial ; the *Emerald* and the *Jacynth* : which are given in the ſame Forms as Pearls ; excepting that their Solutions are not in uſe, as we know of. *Gems.*

^f The Deſign appears to be, that the preceding *Hiſtory*, or Number of ſelect Facts, and Inſtances, from Page 358 to 365, when duly proſecuted and conſidered, ſhould afford a Set of general *Obſervations* of prime Uſe in this Enquiry ; and ſhew the Courſes of Life that have the leaſt and greateſt Tendency to procure Longevity.

But we a little suspect these crystalline Gems of Roughness ; or of wounding the Parts like Glafs.

Bezoar.

4. The *Bezoar Stone* is famed for refreshing the Spirits, and causing a gentle Sweat : but the Horn of the Monoceros has lost its Reputation ; tho it still continues upon the same footing with Hartshorn, the Bone of the Stag's Heart, Ivory, &c.

Ambergrease.

5. *Ambergrease* is one of the best things for appeasing and comforting the Spirits.

Warm Medicines.

6. For warming and invigorating, are recommended Saffron, Indian-leaf, *Lignum Aloes*, Citron-peel, Balm, Basil, Avens, Orange-flowers, Rosemary, Mint, Betony, and *Carduus Benedictus*.

Coolers.

7. For Coolers are recommended Nitre, Roses, Violets, Strawberries, both Leaves and Fruit ; the Juices of sweet Lemons, Oranges, and Apples ; Borage, Bugloss, Burnet, Saunders, and Camphire.

Admonition.

As we here mention such Medicines only as may be introduced into Diet, we omit all inflammable distilled Waters and chemical Oils ; and all aromatic, acrimonious, and pungent Remedies ; only recommending it to Mens Consideration, how Waters and Liquors may be prepared from the preceding Ingredients ; not in the way of the common phlegmy Waters, by the Still ; nor, again, with ardent Spirits ; but of a more temperate Nature, yet lively, and breathing a friendly Vapour.

Bleeding suspected, as to Longevity.

8. We are in some Doubt as to the frequent Use of *Phlebotomy*, whether it conduces to long Life, or not ; but rather incline to think it may, when grown into a Habit ; and other things are suited thereto ; because it discharges the old Juices of the Body, and gives occasion to new.

The Cure of emaciating Diseases may contribute to long Life.

9. We likewise judge, that a thorough Cure of certain emaciating Diseases conduces to Longevity, as supplying new Juices in the room of those consumed ; and because, to recover from Sickness is in a manner to grow young again, a kind of artificial Diseases might be procured by means of strict emaciating Diets : but more of this hereafter^s.

^s See below, *Secl. VIII. ad finem* :

S E C T. VIII.

The History of INTENTIONS; with a View to the forming of practical Rules for the Prolongation of LIFE; in pursuance of the twelfth, thirteenth, and fourteenth Articles of the Table of Enquiry.

HAVING now finished our *Enquiry*, with regard to the Objects; viz. in-*Transian.*
animate, vegetable, animal and human Bodies, we must come closer; and conduct the Remainder by *Intentions*, which, in our own Judgment are just, proper, and, as it were, the real Paths of mortal Life. But nothing of moment has hitherto been performed on this Head; Mens Thoughts about it having all along been trifling and unprofitable. Some talk of comforting the natural Heat, and the radical Moisture; of Foods, that make a laudable Blood, neither adust nor phlegmatic; of cooling and refreshing the Spirits, &c. And we take them for well-meaning Men that talk thus: but all this makes little to the purpose. Another Party crys up Medicines prepared from Gold, as from a Body incorruptible; and from Gems, for recreating the Spirits by their Heat and occult Properties. They add, that if the Balms and Quintessences of Animals could be received, and contained in Vessels, there would be great hopes of Immortality: That the Flesh of Vipers, and of Deer, by a certain Consent, have a Power to renew Life; because the one casts the Skin, and the other the Horns. They likewise abound in still stranger Accounts, of an Ointment found buried under Ground, which a Man by using to his whole Body, except the Soles of his Feet, thence lived without any Distemper, (except some Swellings on the Soles of his Feet) to the Age of three hundred: and that *Artesius* growing old, transplanted the Spirit of a young Man into himself; and thus by the Death of another, continued alive for many Years. Others speak much of successful Hours, according to the Horoscope of the Heavens, for collecting and preparing Medicines destined to prolong Life; they talk of *planetary Seals*, whereby to bring down and derive celestial Virtues for the same purpose; with numerous other the like fabulous and superstitious Stories: insomuch that we stand amazed how Men should be so infatuated as to believe such Absurdities; and cannot help commiserating the hard Fate of Mankind, in being beset and pressed on all sides with things vain and useless. But for our own *Intentions*, we have hopes that they close in with things themselves, without any tincture of Fiction, Vanity, or Credulity; and take them to be such, that tho numerous Particulars may be found by Posterity to answer them, yet no great Additions
can

can be made to the *Intentions* themselves. But before we proceed, we must offer a few Admonitions, of the utmost importance to Mankind.

Admonitions.

1. And first we judge, that the Offices of Life are preferable to Life itself; and therefore, tho there should be any thing that might better answer our Intentions, but with Injury to Society, we absolutely reject it. Things of this kind we may perhaps mention; but never insist upon. Thus we have no serious and labour'd Discourse upon Men's leading their Lives in Caves, free from the Inclemencies of the Air; upon perpetual Bathing in prepared Liquors; covering the Body with adventitious Skins, or Oil-clothes; daubing it over with a thick Coat of paint; the Institution of a strict and exact Regimen and Diet, with no other Design than to prolong Life; or the like monstrous, nauseous, and incommodious Methods: but produce only such Remedies and Rules as neither disturb the Duties and Affairs of Life, nor clog them with Delays and Difficulties.

2. Secondly, we earnestly beseech Mankind to trifle no longer, or imagine that so great a Work as to stop and turn back the powerful course of Nature, should be performed by a Mornings-draught, or the Use of a costly Medicine; but to hold it for certain, that a Work of this kind is a laborious Undertaking, which requires a number of Remedies, properly suited to each other; for no one surely can be so dull as to believe, that what was never yet done, should be effected but by Means never tried before.

3. We expressly declare, that some of the things we shall propose were never experienced by us; nor would our course of Life allow thereof; but that they are derived with great Justness, as we judge, from our Principles and Positions, as Parts dug and cut off from the Rock or Mine of Nature: being extremely cautious to propose no Remedies but what are at least safe, if not effectual.

4. We desire Men would observe and distinguish, that the same things do not always contribute both to a healthy and a long Life; for there are some of service in procuring chearfulness of Spirits, strength and vigour of the Faculties, and yet shorten the course of Life. There are also other things very conducive to long Life, tho with some danger to the Health, unless prevented by suitable Means: whereof we shall not omit to give our Intimations and Cautions occasionally.

5. We think proper to propose various Remedies, suitable to each *Intention*; leaving the Choice thereof, and the order of their Application, to Discretion: since it would be too tedious and improper, to publish particular Directions for different Constitutions of Body, or the various kinds of Life, and Ages; so as to shew what Methods are most agreeable to each; in what Order one thing is to be taken after another; and how the whole Praxis and Regimen is in every case to be conducted and observed.

6. In our *Table of Enquiry* we have laid down three general *Intentions*; viz. The prevention of *Waste*; the perfecting of *Recruit*; and the renovation of *Decay*: but as what we have to propose upon these Heads is real Matter, not Words, we shall draw out the three *Intentions* into ten Operations; viz.

(1.) The

(1.) *The Operation upon the Spirits, with a View to their Rejuvenescency.* (2.) *The Operation for excluding the Air.* (3.) *The Operation upon the Blood; and the best Heat for Sanguification.* (4.) *The Operation upon the Juices of the Body.* (5.) *The Operation upon the Viscera, for protruding the Aliment.* (6.) *The Operation upon the external Parts, for attracting the Aliment.* (7.) *The Operation upon the Food itself, for making it insinuate.* (8.) *The Operation upon the last Act of Assimilation.* (9.) *The Operation for mollifying the Parts, after they begin to dry.* And, (10.) *The Operation for discharging the old Juices, and supplying their place with new.* The four former relate to the first *Intention*; the four next to the second; and the two last to the third *Intention*. And as this *Enquiry of Intentions* is directed to Practice; we shall now comprize *Experiments, Observations, Admonitions, Remedies, the Explanation of Causes, Positions,* and whatever belongs to the Subject, under the Name of *History*.

I.

The History of operating upon the Spirits; so as to renew, and continue them in a young, and vigorous State.

1. **T**HE Spirits are the Agents and Fabricators that produce all the Effects in the Body; as appears from numberless Instances. *The Office of the Spirits.*

2. If new and young Spirits could be put into an old Body; 'tis probable that this grand Wheel might give Motion to the rest, and turn the Course of Nature back.

3. In all Consumption, whether by Fire or Age, the more the Heat or the Spirit of the Subject preys upon the Moisture, the less durable that Subject becomes; as is every where plain and obvious.

4. The Spirits are to be put into such a Temper and degree of Activity, as not to drink and drain, but barely to sip the Juices of the Body.

5. There are two kinds of Flame, the one brisk but feeble; which consumes and evaporates light Bodies, as Straw or Shavings, without much affecting the harder: the other strong and constant; which exerts a Force even upon hard and obstinate Subjects; as large Wood and the like. *Two kinds of Flame.*

6. A brisk but weak Flame dries Bodies up, and renders them hard, decay'd and juiceless; and a stronger softens and dissolves them.

7. Some discutient Medicines also breathe out only the thinner Parts in Tumours, and therefore indurate; whilst others discuss more powerfully, and therefore soften. *Effect of discutient Medicines.*

8. So some purging and deterfive Remedies suddenly carry off the more fluid Parts; whilst others draw away such as are more obstinate, and viscous. *Purging Medicines.*

^b Observe, that the whole was afterwards intended to be adjusted, recomposed, verified, and improved, according to the Directions given in the second Part of the *Novum Organum*.

*The Temper re-
quired in the
Spirits.*

9. The Spirits should be possess'd of such a Heat as fits them rather to prey upon and undermine the hard and stubborn Parts, than to discharge and carry off such as are fine and prepared: for by this means the Body remains fresh and firm.

10. The Spirits should be so prepared and wrought as to become dense in their Substance, and durable in Heat, without growing sharp; of such a Quantity as suffices for the Offices of Life, without Redundancy; and of an easy, equable, and not subfultory Motion.

*Effects of Va-
pours.*

11. 'Tis manifest that Vapours have a great Effect upon the Spirits, from the Sleep, the Intoxication, the melancholy and mirthful Passions they procure; and the recovery of Persons in fainting Fits, by Odours.

*The Spirits
condensed four
ways, viz.*

12. The Spirits are condensed four ways; viz. (1.) By Flight; (2.) By Cooling; (3.) By Appeasing; and, (4.) By Quelling. And first for the Condensation by *Flight*.

(1.) By Flight.

13. (1.) Whatever compresses on all sides, drives the Body towards its Centre, and therefore condenses.

*Virtues of
Opium and
Opiates.*

14. *Opium* is an exceeding powerful and effectual Remedy, for condensing the Spirits by Flight or Compressure; and next to this, other Opiates and soporiferous Medicines in general.

15. The Virtue of *Opium* is very remarkable for condensing the Spirits; as about three Grains thereof may presently so coagulate or drive them together, that they shall not recover; but be suffocated and rendered immoveable.

16. *Opium*, and the like Medicines, do not put the Spirits to Flight by their Coldness; for they contain Parts that are manifestly warm: but on the contrary, cool by putting the Spirits to Flight.

17. This Flight of the Spirits by *Opium* and Opiates, appears clearly from the external Application thereof; upon which the Spirits immediately withdraw themselves, and return no more: but leave the Part to gangrenate and mortify.

18. Opiates give ease in violent Pains; as in those of the Stone, or the amputation of a Limb; principally by putting the Spirits to Flight.

19. Opiates have a good Effect from a bad Cause: for to disturb the Spirits from their Seat is bad; but the Condensation of them by that Disturbance is good.

20. The *Greeks* laid great stress upon Opiates, both for the preservation of Health and the prolongation of Life; and the *Arabians* still more: inso-much that their capital Medicines have *Opium* for the Basis and principal Ingredient; with the Addition of other things to abate and correct its noxious Qualities, as in *Venice-Treacle*, *Mithridate*, &c.

21. Whatever is successfully used in the Cure of pestilential and malignant Diseases, to check and curb the Spirits, and keep them quiet, may be advantageously transferred to the prolongation of Life; as the same thing, viz. the Condensation of Spirits, is effectual in both Cases: and this End is chiefly procured by Opiates.

22. The *Turks* find Opium, even in a large Quantity, innocent and cordial; insomuch that they take it before they go to Battle, as a means of inspiring Courage: but to us 'tis mortal, unless in a small Dose, and well corrected.

23. *Opium* and Opiates are found to excite Venery; which manifests their Power of strengthening the Spirits.

24. The distilled Water of wild Poppy is successfully given in Surfeits, Fevers, and many other Distempers; being, no doubt, a mild kind of Opiate. And let no one wonder that such a Medicine should be used for various purposes; this being the Privilege of Opiates; because, when the Spirits are corroborated and condensed they are able to resist any Distemper.

25. The *Turks* use a kind of Berry called *Coffee*; which they roast, powder, and make into an Infusion with hot Water. The drinking of this, they affirm, adds Strength and Vigour both to the Mind and Body; tho when taken immoderately it disorders the Senses: whence it appears to be a kind of Opiate.

26. A certain Root called *Betel* is celebrated over all the East; the *Indians*, and others, accustoming themselves to chew and hold it in their Mouth; whereby they are wonderfully refreshed, enabled to endure fatigue, throw off Disorders, and strengthen'd for Venery. This also seems a kind of Narcotic; for it gives a great Blackness to the Teeth.

27. The Use of *Tobacco* has spread very wide in our Time; and gives a secret Delight to those who take it; insomuch that the Persons once accustomed thereto find a Difficulty to leave it off: and doubtless it contributes to alleviate Fatigues, and discharge the Body of Weariness. 'Tis also commonly said to open the Passages; and draw off Humours. But its Virtues may be more justly attributed to its condensing the Spirits; as being a Species of Henbane; and, like Opiates, manifestly disturbing the Head.

28. There are sometimes Humours generated in the Body, which themselves act like Opiates; as we find in some kinds of Melancholy, those who are affected therewith proving very long-lived.

29. The *Simple Opiates*, called also *Narcotics* and *Stupescatives*, are *Opium* The simple itself, that is, the exhaled Juice of Poppy; both the *Poppies*, as well the *Opiates*. Plant as the Seed, *Henbane*, *Mandrake*, *Hemlock*, *Tobacco*, and *Nigella*.

30. The *Compound Opiates* are the *Laudanums*, *Venice-Treacle*, *Mithridate*, The compound *Dia-scordium*, *Philonium*, the *Hounds-tongue Pill*, the *Storax Pill*, and *Dia-codium*. *Opiates*.

31. From what is before laid down may be deduced certain Directions, Rules for the prolongation of Life, with regard to this Intention of condensing the Spirits by Opiates. *Rules for prolonging Life by Opiates.*

32. For example: from the time of full Growth, let an opiate Diet be instituted yearly, and entered upon about the end of May; because the Spirits are most dissolved and attenuated in the Summer; and the Danger is then the less from cold Humours: but let the Opiate employ'd be a commanding one; tho weaker than those in use, as receiving a less proportion of *Opium*, and a more sparing addition of the very hot Ingredients. Let it be *An opiate Diet.*

taken in the Morning ; sleeping upon it. The Diet should, at this time, be simple and sparing ; without Wine, Spices, or any thing sweating. Let the Medicine be taken only every other Day ; and continued for a Fortnight. And the Design of this Rule, in our Judgment, duly answers the Intention.

Opiate Fumes. 33. Opiates also may be received not only by the Mouth, but in the way of Fumes ; tho this should be done in such a manner as not greatly to affect the expulsive Faculty, or drain off the Humours ; but for a short time only, to operate upon the Spirits in the Brain : and therefore, in a Morning, a Suffumigation, of Tobacco, mixed with *Lignum Aloes*, dried Rosemary, and a little Myrrh, received a-while at the Mouth and Nostrils, may be of service.

Distilled Waters of Opiates. 34. For the capital Opiates, such as *Venice-treacle* and *Mithridate*, 'twere proper, especially in Youth, to use the distilled Waters thereof, rather than the Medicines themselves ; because the Vapour of the Medicine rises, and its Heat is greatly kept back by Distillation : for distilled Waters are generally excellent in the Virtues that rise by Vapour ; but poor and weak in other respects.

Opiates inspissating the Spirits. 35. There are Medicines which have a certain feeble, secret, and therefore safe opiate Virtue. These yield a copious, but sluggish, and not malignant Vapour, as other Opiates do ; and therefore put not the Spirits to Flight, but only collect and somewhat thicken them.

The milder Opiates, or Substitutes for the stronger. 36. The milder Opiates, or Substitutes for the stronger, are principally Saffron, the Indian-leaf, *Ambergrease*, *Amomum*, *Pseudamomum*, *Lignum Rhodium*, *Orange-flower Water* ; but much rather an Infusion of the fresh Flowers in Oil of Almonds.

Saffron. 37. Tho the stronger Opiates are to be used but very sparingly, and at certain times ; this milder sort may be used common, and in daily Diet : and they contribute greatly to prolong Life. An Apothecary of *Calicut*, is, by the Use of *Ambergrease*, reported to have lived a hundred and sixty Years ; and the Nobility of *Barbary* are, by the Use thereof, found to be long lived ; whilst the common People there are but short lived. And our Ancestors, who made a frequent Use of *Saffron* in their Cakes, their Broths, &c. lived much longer than we do. And so much for the *Condensation of the Spirits* by Opiates, and their Substitutes.

(2.) The Condensation of the Spirits by Cold. 38. (2.) We come now to the second manner of condensing the Spirits ; viz. by Cold. And first, Condensation is the proper Effect of Cold ; and performed without any Malignity or unfriendly Quality : whence its Operation is safer than that of Opiates, tho somewhat less powerful, if used only by turns, as Opiates are : but as it may be employ'd familiarly and with moderation ordinarily, it has a much greater Effect than Opiates in the prolonging of Life.

The Spirits cooled three ways. 39. The Spirits are cooled three ways ; viz. (1.) By Respiration. (2.) By Vapour. And, (3.) By Aliment. The first is the principal, but somewhat out of our command ; the second also is powerful, and within our compass ; but the third is weak and slow.

40. A clear and pure Air that has nothing fuliginous, nor felt much of *By the Air.* the Sun's Heat before 'tis received into the Lungs, excellently condenses the Spirits. And such an Air is found on the dry tops of Mountains, or in open Champains, that are brushed by the Wind, but screened from the Sun.

41. As to the cooling and condensing of the Spirits by Vapours; we *Nitre,* place the Foundation of this Operation in *Nitre*, as a Subject chosen and peculiar to this end, for the following Reasons.

42. *Nitre* is a kind of cold Aromatic, as appears from the Sense itself; *Its Nature,* for it bites and vellicates the Tongue and Palate with Cold, as Spices do *and Effects.* with Heat; and is the only thing, that we know of, which has this Property.

43. All cold Bodies that are properly, and not accidentally cold, as *Opium*, contain but little, and a jejune Spirit; whilst, nearly all the hot Bodies are full of Spirit. *Nitre* is the only Body in the vegetable Kingdom that, tho' cold, abounds with Spirit; for *Camphire*, which is spirituous, yet performs the Actions of Cold, refrigerates only by accident; *viz.* by its Tenuity, without Acrimony, and by promoting Perspiration in Inflammations.

44. In the congelation and freezing of Liquors, lately introduced by the Application of Snow and Ice without-side the containing Vessel, *Nitre* is used as an Ingredient; and doubtless both excites and strengthens the freezing Power. 'Tis true, common Bay-salt is used for the same purpose; but this rather actuates the Cold of the Snow or Ice, than gives a Coldness of itself. But I have been told, that in the hotter Regions, where no Snow falls, Congelation has been performed by *Nitre* alone: tho' this is not hitherto verified¹.

45. Gunpowder, whereof *Nitre* makes the principal Ingredient, is reported, when drank, to inspire Courage, and to be frequently taken by Sailors and Soldiers before Battle; as *Opium* is by the *Turks*.

46. *Nitre* is successfully given in Calentures, and pestilential Fevers; to suppress and cool their destructive Heats.

47. 'Tis very manifest from Gunpowder, that *Nitre* has a great Aversion to Flame; whence proceeds that surprizing Ventosity and Explosion.

48. *Nitre* is found to be, as it were the Spirit of the Earth; for 'tis certain that any clean Earth, unmix'd with nitrous Bodies, thrown on Heaps, and kept covered and screened from the Sun, so as to afford no Vegetables, will copiously collect *Nitre*: whence 'tis manifest, that the native Spirit of *Nitre* is of a lower rank than the Spirit of Animals, or even of Vegetables.

C c c 2

49. Ani-

¹ I suppose this is meant of the Coolness which *Nitre* communicates to Water, during the time it continues dissolving therein. But does not the Act of Congelation require *Sal-armoniac* instead of *Nitre*; and a second or third repetition of the Solution, after both the Salt and the Water have remained in the former Solutions, to acquire their degrees of Cold respectively? For scarce any Salt will produce Ice upon being barely dissolved in the Water of a warm Climate; unless the Water be considerably cooled before. See *Sylva Sylvarum*, under the Articles, COLD, COOLNESS, and HEAT.

49. Animals that drink nitrous Water grow manifestly fat ; which is a sign of Coldness in *Nitre* ^k.

50. Land is best improved by nitrous Bodies ; and all Manure is nitrous ; which shews there is a Spirit in *Nitre*.

51. From all which 'tis plain, that the human Spirits may be cooled and condensed by the native Spirit of *Nitre* ; and at the same time rendered more dense and less consuming : and therefore, as strong Wines, Spices and the like inflame the Spirits and shorten Life ; so *Nitre*, on the other hand, composes and condenses them, and conduces to Longevity.

*How Nitre
may be used.*

52. *Nitre* may be used at Meals, mixed along with nine Parts of Table-salt ; it may also be taken with the Breakfast or Mornings-draught, from three Grains to ten : but in what way soever it be moderately used, 'tis highly conducive to long Life.

*The Substitutes
for Nitre.*

53. As *Opium* stands first in Virtue for condensing the Spirits by Flight, and has its less powerful but safer Subalterns ; which may be taken in larger Doses, and with greater frequency : so *Nitre* likewise, which stands first for condensing the Spirits by Cold, or rather by cooling and refreshing them at once, has its Substitutes.

54. The Substitutes for *Nitre*, are those things which yield an Odour somewhat earthy ; as that of clean and good Earth, newly broke or turned up with the Plough or Spade. Among the principal of these are *Borage*, *Bugloss*, *Langue de Bœuf*, *Burnet*, *Strawberry the Fruit and Leaf*, *Raspberries*, raw *Cucumbers*, raw *Apples*, *Vine-leaves*, *Vine-buds*, and *Violets*.

55. Next to these come such as have a certain greeness or rawness of Smell, with some tendency to warmth, yet not without a cooling Property ; as *Balm*, green *Lemmons*, green *Oranges*, *Rose-water* ; the pale, the damask, the red, and the musk *Rose*.

56. Let it be observed, that the Substitutes for *Nitre*, generally answer the Intention better in a crude State, than after having felt the Fire ; because the cooling Spirit is dissipated by Heat : whence they are best taken, either infused in *Liquor*, or without Preparation.

57. As the Spirits are somewhat condensed by the Substitutes for *Opium*, so likewise are they by the Odour of the Substitutes for *Nitre* ; so the smell of fresh and clean Earth, received either by following the Plough, or by digging or by weeding in the Garden, excellently composes the Spirits ; which are likewise finely refreshed by the scent of the Leaves that toward the end of Autumn fall in the Woods and Hedges ; but above all, by the Breath of a dying *Strawberry-bed* : and the Odour of *Violets*, *Wall-flowers*, *Bean-blossoms*, *Sweet-briar*, and *Honey-suckles*, has a like Effect whilst they are growing. And I knew a certain Nobleman of a great Age, who, as soon as he awaked in the Morning, had a piece of fresh Earth every Day brought him, in order to receive its Odour.

58. And no doubt but the Blood being cooled and tempered by such cold Plants as *Endive*, *Succory*, *Purslain*, &c. might consequently cool the Spirits ; but

^k Where are these nitrous Waters found ? or what is here properly meant by *nitrous Waters* ?

but this is a slow and indirect way ; whereas Vapours operate immediately. And so much for the Condensation of the Spirits by Cold.

59. (3.) The third kind of *Condensation* is by *appeasing the Spirits*. Now (3.) By *appeasing the Spirits*. the Spirits are appeased by such things as prove grateful and acceptable to them, without exciting or calling them out too much ; but rather incline them to Complacency and Self satisfaction, and to keep themselves within their own Sphere. But the Particulars of this Enquiry are already satisfy'd by what is above delivered upon the Substitutes for *Opium* and *Nitre*.

60. (4.) And for the fourth kind of *Condensation*; viz. by quelling the too great Vigour, and checking the Impetuosity of the Spirits, we shall speak to it below, when we come to enquire into their Motions¹. So that having already spoke to their Condensation, which regards the Substance of them ; we next proceed to their degree of *Heat*.

61. 'Twas before observed, that the Heat of the Spirits should be neither great nor consuming ; but such as rather fits them to prey upon the hard resisting Parts, than to carry off the light and fine ones^m.

62. Spices, Wine, and spirituous Liquors must be guarded against, and used with great moderation, and with intervals of Abstinence. The same Caution reaches to Thyme, Marjoram, Penny-royal, and all hot and inflammatory Plants, which impart not a recruiting, but a predatory Heat to the Spirits.

63. But a prudent and judicious Use of these Simples, sometimes by way of Food, and sometimes by way of Physick, will answer this Intention ; viz. *Ellicampane*, *Carduus Benedictus*, young *Cresses*, *Germander*, *Angelica*, *Zedoary*, *Vervain*, *Valerian*, *Myrrh*, *Costmary*, *Elder-flowers*, and *Chervil*.

64. It happens fortunately also, that the capital *Opiates* are of excellent Use in this Operation ; as by Composition they afford such a Heat as is wished for, but scarce found in Simples ; for by mixing together such hot things as *Euphorbium*, *Pellitory*, *Birthwort*, *Opopanax*, *Ammoniacum*, *Galbanum*, &c. to blunt the narcotic Virtue of the Opium, Physicians make the Medicines here required ; as is excellently seen in the *Theriaca*, *Mithridate*, &c. which are not biting and pungent to the Tongue, but only somewhat bitter, and of a strong Scent, exerting their Warmth in the Stomach, and the subsequent Passages.

65. A frequent Excitation to Venery, but rarely performing the Act, conduces also to give the Spirits a robust Heat ; and the like may be said of some other Passions : of which hereafter. And so much for the Heat of the Spirits disposing to long Life.

66. As to the *Quantity of the Spirits*, with a View to keep them down, and prevent their over Proportion, 'tis but a short Enquiry ; since a small Flame does not devour so much as a large one.

67. It seems confirmed by Experience, that a slender and almost *Pythagorean*, monastic, or hermetic Diet, regulated by Penury and Want, conduces to Longevity. Such a Regimen turns upon the drinking of Water, lying hard, the use of a cold Air, eating of Herbs, Fruits, dried Flesh, and dried.

¹ See below, § 70—74, and 86—94.

^m See above, § 4.

dried Fish, wearing of Hair-shirts next the Skin, frequent Fasting, frequent Watching, few sensual Pleasures, &c. all which diminish the Spirits, and reduce them to a Quantity barely sufficient to support the Offices of Life; whence they are rendered less predatory.

One a little less severe.

68. But if the Regimen be not altogether so rigorous and mortifying, yet continually equable and uniform, it has the same Effect; as a greater Flame, when uniform and undisturb'd, consumes less of its Subject, than a small one agitated stronger, and weaker by Fits. And we have an eminent Example of this in the Regimen and Diet of *Cornaro the Venetian*; who for many Years continued to eat and drink by exact Weight: thus preserving himself in full strength of Body, and vigour of Senses, to more than a hundred Years.

Seasonable use of Venery.

69. Regard likewise must be had, that the Body which is nourished to the full, and not emaciated by the strict Regimen above-mentioned, omit not the seasonable use of Venery; lest the Spirits should grow too turgid, and thus soften and relax the Body. And so much for the moderate and frugal Quantity of the Spirits.

The Motion of the Spirits check'd three ways.

70. Next follows the Enquiry of checking the Motions of the Spirits; for Motion manifestly tends to attenuate and over-heat them. They are checked three ways, viz. (1.) By Sleep; (2.) By avoiding vehement Labour, immoderate Exercise, and Languor; and, (3.) By bridling all troublesome Passions. And first of Sleep.

Viz. (1.) By Sleep.

71. The Fable goes of *Epimenides*, that he slept many Years in his Cave without eating; for the Spirits waste and prey but little in Sleep: and Experience shews that Dormice, Bats, Swallows, &c. shut up in close Places, sleep the whole Winter: the same is also supposed of Bees and Drones, tho sometimes destitute of Honey; and again of Butter-flies, Flies, &c.

72. Sleep in the Afternoon is good for the Spirits; as no unfriendly Vapours then ascend to the Head, and only the first light Dew of the Meal; tho in all other Respects with regard to Health, 'tis pernicious and oppressive: but in extreme old Age, both Meals and Sleep shou'd be frequent, tho short and small; and in the last Stage of a long Life, perpetual Rest and Repose are serviceable, especially in the Winter. And as moderate Sleep contributes to prolong Life; it does it so much the more where it is pleasing, and not broken or disordered.

73. Quiet Sleep is procured by Violets, Lettuce, especially boil'd; Saffron, Balm, Apples eat at going to Bed; Toast and *Malmsey*, particularly if Musk-roses are first infused in the Wine. 'Twere therefore proper to compose a Pill, or some small Draught of these Ingredients; and to use it often. Those Things likewise which close the Mouth of the Stomach, as prepared Coriander-seed, Quinces and roasted Pears, cause pleasing Sleep. But above all Things in Youth, especially if the Stomach be strong, a good draught of cold Water is proper at going to Bed.

Admonition.

As to the Business of *Trances*, whether voluntary or procured, and of intent and deep Thought, tho without Perturbation, we have nothing certain to offer; they may doubtless contribute to this Intention, and condense

denſe the Spirits more powerfully even than Sleep ; as they lull and ſuſpend the Senſes as much or more than that : but of theſe Particulars let farther Enquiry be made. And ſo much for the Affair of Sleep.

74. We next proceed to *Motion* and *Exerciſe*. Laſſitude is prejudicial : ſo is too ſudden and violent Motion and Exerciſe ; as Running, Tennis, Fencing, and the like ; ſo again is all endeavouring beyond the Strength, as in Leaping, Wreſtling, &c. 'Tis certain that when the Spirits are ſtrained, either by velocity of Motion, or by extreme Efforts, they afterwards become more predatory and conſuming. On the other Hand, the Exerciſes that require a moderately robuſt Motion, but not too quick, or beyond the utmoſt ſtrength ; as Dancing, Shooting with the long Bow, Riding, Bowling, &c. are rather beneficial than hurtful.

75. We now come to conſider the Affections and Paſſions of the Mind, to ſee which of them conduce to, and which of them prevent long Life. And firſt, extreme Joy attenuates and diſſipates the Spirits, and ſhortens Life ; but familiar Chearfulneſs corroborates the Spirits without reſolving them.

76. Senſual Impreſſions of Delight are bad ; but the Thoughts of Joys paſſing in the Memory, or the Apprehenſions of them in Hope, and Expectation, are good.

77. A ſuppreſſion, or gradual communication of Joy, recreates the Spirits more than profuſe and ſudden Joy divulged all at once.

78. Grief and Sadneſs, if unattended with Fear, and not too afflictive, prolong Life ; for they contract the Spirits, and cauſe a kind of Condensation.

79. Great Fears ſhorten Life ; for tho' Grief and Sadneſs condense the Spirits, yet they cauſe only a ſimple Contraction ; whiſt in Fear, by reaſon of the Sollicitude after the Remedy, and an intermixture of Hope, there is a kind of tormenting Flux and Reflux made of the Spirits.

80. Anger, when ſuppreſſ'd, is alſo a kind of Torture, and cauſes the Spirits to prey upon the Juices of the Body ; but when it has vent and breaks out, it becomes of ſervice ; as thoſe Medicines do which procure a robuſt Heat.

81. Envy is the worſt of Paſſions, and feeds upon the Spirits, and theſe again upon the Body ; the more becauſe 'tis a laſting Paſſion ; and as the Expreſſion goes of it, keeps no Holy-days.

82. Pity for the Miſfortunes of others, which ſeem not likely to fall upon ourſelves, is good : but that, which by a kind of Similitude may reflect upon the pitying Perſon is bad ; on account of the Fear it excites.

83. Moderate Shame hurts not, as it ſomewhat contracts and again diſperſes the Spirits ; inſomuch that baſhful Perſons are generally long lived : but Shame ariſing from ſome great Ignominy, and continuing long to aſſiſt, contracts the Spirits even to Suffocation, and is deſtructive.

84. Love, if ſucceſſful, and not deep, is a Species of Joy, and comes under the Rules above laid down of that.

85. Hope,

Hope.

85. Hope, is of all the Passions the most advantageous, and greatly contributes to prolong Life ; if it be not too often disappointed, but entertains the Imagination with a Prospect of Good : whence they, who fix and propose to themselves any End as the Pursuit of their Life, and constantly advance by degrees therein, are generally long lived ; but coming at length to the top of their Hopes, and having nothing further to expect, they commonly languish and die soon after ; so that Hope may seem a kind of Leaf-joy, and like Gold, extremely ductile.

Miscellaneous
Observations
upon the Spi-
rits.

86. Admiration and moderate Contemplation have a great Power to prolong Life ; for these detain the Spirits upon pleasing Subjects, without suffering them to tumultuate and act disorderly : whence all the Contemplators of natural Things, who had so many and such great Objects of Admiration ; as *Democritus*, *Plato*, *Parmenides*, and *Apollonius* were long lived. So likewise were the Rhetoricians, tho they only tasted such Subjects, and pursued the Light of Discourse rather than the Darknes of Things ; as *Gorgias*, *Protagoras*, *Isocrates*, *Seneca*. And indeed as old Men are generally prating and talkative ; so great Talkers very often live to be old : for this is a sign of slender Contemplation, which does not much affect or torture the Spirits ; but subtle, acute and severe Enquiries cut Life short ; for these fatigue and wear out the Spirits. And so much for the motion of the Spirits from the Passions of the Mind ; whereto we will add a few general Observations upon the Spirits, that fall not under the preceding division.

The Spirits not
to be dissolved.

87. Particular Care must be had, that the Spirits be not often dissolved ; for Rarefaction precedes Dissolution : and the Spirits once rarefied cannot easily recover themselves, and become dense again. The Spirits are diffused by hard Labour, vehement Passions of the Mind, profuse Sweats, large Evacuations, warm Bathing, and the immoderate or unseasonable use of Venery ; again, by too great Cares, anxious Disquietudes and Expectations ; and lastly by malignant Diseases, and severe Pains and Tortures of the Body ; all which are, as much as possible, to be avoided.

How refreshed.

88. The Spirits are refresh'd by Things whereto they are both accusom'd and unaccusom'd. It strangely conduces to preserve the Vigour of the Spirits, not to use customary Things to Satiety, nor new ones before a strong and vigorous Appetite requires them ; and therefore Customs are to be broke off with Judgment and Diligence before Aversion comes on ; and the desire of Change is to be restrain'd for a time, till become strong and vigorous. The course of Life must likewise be so ordered, as to have many and various Renovations ; that the Spirits may not grow sluggish by perpetually conversing with the same Things. For altho *Seneca* sharply said, *the Fool is always beginning to live* ; yet this Folly, and numerous others, are conducive to long Life.

The Spirits to
be regulated.

89. It must be observed, contrary to what is usually done, that when Men perceive their Spirits to enjoy a good, a sound and a pleasing State, which appears from a greater Tranquillity and Pleasure of Mind, they are then to cherish and not to change them ; but when they are in a restless and dis-

orderly state, which also appears from Melancholy, Indolence, and other Indispositions of the Mind, they are sometimes to oppress and alter them. Now the Spirits are preserved in the same state, by restraining the Passions, moderating the Diet, abstaining from Venery, and by using moderate Labour, and moderate Rest. They are altered and oppress'd by the contrary; viz. vehement Passions, Gluttony, immoderate Venery, hard Labour, intense Thinking, and much Business. But 'tis the practice of Men, when they are chearful, and best pleas'd with themselves, then most to affect and pursue Feasting, Venery, Labour, Difficulties, and Business. Whoever desires to prolong Life, must act in a contrary manner; and endeavour to support and preserve the good Condition of his Spirits; and discharge and change them when ill disposed.

90. 'Tis well observed by *Ficinus*, that old Men, to refresh their Spirits, should frequently recollect and ruminate upon the Actions of their Youth and Childhood: and certainly such kind of Remembrance is, as it were, the peculiar recreation and delight of old Men; whence 'tis pleasant for Men to enjoy the Company of those they were educated with; and to visit the places where they were brought up. And *Vespasian* gave so much into this Humour, that when he was Emperor, he cou'd not prevail upon himself to quit his Father's homely House; for fear of losing his accusom'd Objects, or some part of the Memory of his Youth. *How refreshed in Age.*

91. But the most grateful Thing to the Spirits is, a continual Progression for the better; and therefore Youth and riper Years shou'd be so conducted as to leave new Comforts for old Age: the principal whereof is moderate Rest; whence old Men in Posts of Honour, offer Violence to themselves, if they do not retire. Of this we have a remarkable Example in *Cassiodorus*, who was of such Authority among the *Gothick* Kings of *Italy*, as to be the Soul of their Affairs; but retiring to a Monastery at near the Age of eighty, he there continued to a hundred. But in this Respect two Cautions are required; the first is, that they wait not till the Body is quite wore out and distempered; for in that case all Change, tho for the better in appearance, hastens Death: the second, that they give not themselves up to perfect Indolence, but have something gratefully to amuse their Thoughts and feed the Mind: to which purpose Letters are best suited; and next to these, Building and Planting. *Old Men to retire from Business.*

92. Lastly, one and the same Action, Study, or Labour, undertaken by Choice, and with a willing Mind, refreshes the Spirits; but if against the Inclination, it wastes and destroys them: 'tis therefore conducive to long Life, either that a Man so shape his Course by Art, as to have it free and according to his own wish; or else procure himself such a pliable Temper, that whatever is imposed upon him by Necessity, may rather lead than drag him. *Involuntary Studies waste the Spirits.*

93. We must not omit, with regard to the Government of the Passions, that particular Care should be had of the Mouth of the Stomach; but principally to keep it from being too much relaxed; because this part has a greater influence over the Passions, especially the daily ones, than either *The mouth of the Stomach to be regarded.*

the Heart or Brain ; excepting only such as proceed from powerful Vapours, as in Drunkenness and Melancholy.

The present Enquiry why more diligently prosecuted.

94. And thus much for the *Operation upon the Spirits*, with a view to continue them in a flourishing and youthful state : wherein we have used the greater Diligence, because Physicians and other Writers scarce touch upon it ; but chiefly because the Operation upon the Spirits, and making them young again, is the readiest and shortest way to prolong Life, on account of two Abridgments ; the one, that the Spirits operate immediately upon the Body ; the other that Vapours and the Passions operate immediately upon the Spirits : so that these Things go directly, and in a strait Line to the end ; whilst others reach it by a Curve.

II.

The History of the Operation for excluding the Air from the Body.

Exclusion of the Air has a double Tendency to prolong Life.

1. **T**HE exclusion of the Air, has a double Tendency to prolong Life ; *first*, as after the native Spirit, it more than any other Thing preys upon the Juices, and hastens the dryness of the Body ; so that how much soever Air may otherwise animate, and contribute to Health ; yet the shutting of it out, externally, conduces to Longevity.

2. The *second* Effect, which follows upon excluding the Air, is much more deep and subtle ; for the Body being clos'd up, and not perspiring, detains the included Spirit, and turns it into the harder Parts of the Body ; which therefore are kept soft and tender by the Spirit.

Bodies how dried.

3. The manner of this Action appears in the desiccation of inanimate Bodies ; and 'tis a certain *Axiom*, that Bodies are dried by the Avolation of their Spirit ; but rendered soft and yielding by its Detention. It must likewise be allowed the property of all Heat, to moisten and attenuate ; and to contract and dry only by accident.

The living in Caves,

4. To live in Caves and Dens, where the Air receives not the Sun's Rays, may conduce to Longevity ; as the Air of itself, without being animated by Heat, has no great Force to prey upon the Body. And if we go backwards, it will appear from many Remains and antient Monuments, that the Size and Stature of certain Men have been much larger ; and that these Men generally lived in Caves : and there is some Affinity between length of Age, and largeness of Limbs. We also suspect the Life of the *Stylites*, or *Anchorites* of the Pillar, bore some resemblance to a Life led in Caves ; their Bodies being secured, or skreened from the Sun's Heat ; and the Air they breathed not being subject to great Changes or Inequalities. Thus much is certain, that both the *Symeons*, and *Daniel*, and *Saba*, as well as other *Stylites*, were very long lived. And even the modern *Anchorites*, who were either immured, or shut up in Pillars, have frequently lived long.

5. Next to the living in Caves, is living upon Mountains; for as the Sun's Heat penetrates not into Caves, it has but little Effect on the tops of Mountains, for want of Reflection. But this must be understood of Mountains where the Air is clear and pure, or where, by reason of the dryness of the Valleys, no Clouds or Vapours ascend; as in the Mountains round *Barbary*, where to this Day, Men often live to a hundred and fifty Years. *Living on Mountains.*

6. But tho the Air of these Caves or Mountains is not of its own nature considerably predatory; yet, as the Air we live in is rendered so by the Sun's Heat, the Body ought, as much as possible, to be secured against it. *The Body to be guarded against the Air.*

7. The Air may be excluded two ways; first by contracting the Pores, and again by filling them up. *Two ways of excluding the Air.*

8. For contracting or shutting up the Pores, the coldness of the Air itself is serviceable; so are uncovering of the skin, which hardens it; bathing in cold Water; and Astringents used externally, such as *Mastich*, *Myrrh*, *Myrtle*, &c. *By closing the Pores.*

9. But this Intention is much better answered by Baths (tho to be seldom used, especially during the Summer) consisting of such astringent mineral Waters, as may be safely drank; for Example, those of *Chalybeate* and *vitriolic Springs*; which powerfully contract the Skin. *Bathing.*

10. As for filling up the Pores; Paints and the like thick unctuous Bodies, or, what may be used with more Convenience, Oil and Fats preserve the Substance of the Body, as much as Oil-paint and Varnish preserve Wood. *Paints.*

11. The antient *Britons* painted themselves with Woad, and were very long lived; so likewise did the *Picts*; who are from thence thought by some to have derived their Name, which signifies painted Men. *Used by the Britons.*

12. The Inhabitants of *Brazil* and *Virginia* paint themselves to this Day, and are very long lived, especially the *Brasilians*; insomuch, that five Years since, the *French* Jesuits met with some of them who remember'd the Building of *Fernamburg*; a hundred and twenty years backwards; and yet were Men grown at the Building thereof. *Brasilians.*

13. *Johannes de Temporibus*, who is reported to have lived three hundred Years, being asked by what means he preserved himself, is said to have answered, by Honey within, and Oil without. *Johannes de Temporibus.*

14. The *Irish*, especially the *Wild-Irish*, are to this Day very long lived; and they report, a few Years ago, that the Countess of *Desmond* lived to a hundred and forty, and shed her Teeth three times: and 'tis a practice with the *Irish*, to anoint themselves with old salt Butter before the Fire. *The Irish.*

15. The *Irish* also were accustom'd to wear their Shirts and Linen stained with Saffron; which practice, tho first introduced to prevent Putrefaction, yet we judge it of the same Service in prolonging Life: for Saffron, of all the things we know, is the best for cherishing the Skin, and the Flesh; as it has a remarkable Astringency, Oiliness, and a subtile Heat, without Acrimony. And I knew an *Englishman*, who carried a Bag of Saffron about his Stomach in a Voyage, to conceal it and prevent paying the Duty; and tho at *The external use of Saffron.*

other times he used to be exceedingly Sea-sick, he now continued perfectly well without the least Retching.

Anointing
with Oil.

16. *Hippocrates* advises to wear clean Linen next the Skin in the Winter, but foul and besmeared with Oil in the Summer; the Reason whereof seems to be this, that the Spirits greatly exhale in the Summer; and therefore the Pores of the Skin are then to be fill'd up.

How to be
practised.

17. We therefore judge that anointing the Skin with Oil, either that of Olives or sweet Almonds, greatly conduces to long Life. And this should be done every Morning upon rising; and with Oil wherein a little Bay-Salt and Saffron is mix'd; but it ought to be laid on light, with Wooll, or a soft Sponge, not so as to run, but barely to bedew and moisten the Skin.

18. 'Tis certain that Liquors, even such as are oily, used in a large quantity, draw somewhat from the Body; but on the contrary are imbibed by it in a small one: and therefore, as we said, the Unction must be but slight and superficial; or else let only the Shirt itself be a little rubbed with the Oil.

Whether used
in this manner
by the An-
tients.

19. It may here be objected, that this anointing with Oil, tho not used among ourselves, has however been experienced, and left off by the *Italians*; and was antiently familiar, and a part of Regimen among the *Greeks* and *Romans*; yet Mankind in those Ages were not longer lived than at present. To which it may be justly answered, that they used their Oil only after warm Bathing; unless we except their Gladiators and Wrestlers; but warm Bathing is as contrary to this *Intention* of ours, as anointing is congruous; the former opening, but the latter blocking up the Pores: and therefore warm Bathing, without subsequent anointing is extremely bad for our purpose; but anointing without Bathing excellent. Their anointing also was used in the way of Delicacy, or at best to preserve Health; but in no respect to procure long Life: whence they employ'd at the same time precious Unguents, which, tho grateful and pleasing in themselves, are prejudicial in our Intention, by reason of their Heat. Whence *Virgil* seems to have well observed, that the use of Oil was corrupted with Spices^a.

Anointing
how healthy.

20. Anointing with Oil contributes to Health in the Winter, by excluding the Cold; and in Summer by keeping in the Spirits, and preventing their Dissolution; as also by fencing against the force of the Air, which is then most predatory.

Four Cautions
to prevent ill
Effects from
anointing.

21. As anointing with Oil is one of the most powerful Remedies for prolonging of Life, we shall here add a few Cautions about its Use, to prevent endangering the Health: and these Cautions are principally four, with regard to the four Inconveniences that may follow upon it.

viz.
Stopping the
Sweat.

22. The *first* Inconvenience is, that by suppressing the Sweat, it may produce Distempers from excrementitious Humours; but this may be remedied by the use of Purges and Glysters, so as to procure a proper Discharge; for 'tis certain, that Evacuation by Sweat has a general tendency to

^a Nec *Cassia* liquidi corrumpitur usus olii.

to Health, but shortens Life; whilst moderate Purgatives operate upon the Humours, and not, as Sweat does, upon the Spirits.

23. The *second* Inconvenience is, that our anointing may sometimes heat and inflame the Body; because the Spirits when shut up, and not suffer'd to perspire grow warm: but this is prevented by a cooling Diet, and the use of some proper Refrigerants at due Intervals; of which more, in our next Enquiry into the Operation upon the Blood.

Heating the Body.

24. The *third* Inconvenience is, that it may oppress the Head; as all external Obstruction strikes back the Vapours, and turns them upon that Part: but this is entirely prevented by Catharticks; especially by Glysters, and strongly closing the Mouth of the Stomach with Astringents: again also by combing and rubbing the Head, along with the use of proper perspirative Lixiviums; not omitting suitable Exercise, that some Perspiration by the Skin may likewise be procured.

Oppressing the Head.

25. The *fourth* Inconvenience is more subtle; viz. that the Spirits detain'd by closing up the Pores may seem to multiply too fast; because, as little exhales, and new Spirit is constantly produced, the quantity may increase too much; and so the Body come to be more prey'd upon: but this is not entirely the Case; for all Spirit shut up and not fann'd, becomes languid, like Flame unanimated by Air; whence it becomes less active, and less productive of new: but doubtless its Heat is thus increased, tho its Motion be retarded; which is likewise the Case of Flame. But this Danger may be prevented, by sometimes mixing refrigerant Ingredients along with the Oil, such as Roses, and Myrtle; for no hot Things are here to be used.

Over increasing the Spirits.

26. It may be likewise serviceable to wear such Garments as are somewhat unctuous or oily, and not aqueous; because these exhaust the Body less: such are those of Callico rather than Linen. And 'tis manifest, that the Spirits of odorous Bodies hang much longer in Woollen than Linen; and therefore tho Linen is more elegant and grateful to the Touch, yet we suspect it for this Intention.

Woollen Garments prefer'd to Linen.

27. 'Tis a practice among the wild *Irisb*, when first taken sick, immediately to unsheet their Bed, and roll themselves in the Blankets. And some declare themselves to have with great Advantage to their Health, wore flannel Waistcoats and Drawers next their Skins.

28. It must also be observed that the *Air*, whereto the Body is accustomed, consumes less than new, or a frequent change of Air; whence poor People that never remove from their own Roof, are generally long lived: in other Respects, we judge a change of Air to be useful, especially to those of brisk Spirits; but a Moderation herein may prove best on all accounts. The way wou'd be to change the place of aboad, and at stated times remove to proper Seats, suited to the four Seasons of the Year; whereby the Body might have neither too much fatigue in Travelling, nor too much rest at Home. And this for the Operation of excluding the Air, to avoid its predatory or consuming Force.

Accustom'd Air less predatory.

III.

The History of the Operation upon the Blood, and the proper Heat for Sanguification.

1. **T**HE present and the following Operation are the Converse of the two foregoing; and answer to them as Passives to Actives: for as those prevent the Spirits and Air from being too predatory in their Actions; so these secure the Blood and Juices of the Body, and keep them indisposed to be prey'd upon. But as the Blood is the Fountain that supplies the Juices, waters the Parts, and is the Matter prepared for composing them, we assign the first place to the Operation upon the Blood; with regard whereto we shall lay down three very effectual Directions.

The Blood to be cooled.

2. And first, no doubt if the Blood be brought to a cooler Temper, it will become less dissipable; but as Refrigerants taken by the Mouth, ill comport with many other Intentions, 'tis most advisable to find out others, not subject to such Inconveniences: and there are two of them.

By the use of Glysters.

3. The one is, the use of Glysters, in no respect purging or absterfivè, but only cooling and somewhat opening; to be injected principally in Youth: and those are best approved which consist of the juice of Lettuce, Purslane, Liverwort, the greater Houfeleek, and the Mucilage of Fleawort-feed; with the addition of some moderately aperient Decoction, and the admixture of a little Camphire: but in declining Age, let the Houfeleek and the Purslane be omitted; and the Juices of Borage, Endive or the like be substituted for them. These Glysters shou'd be retain'd as long as possible, or for an Hour or more.

Warm Bathing.

4. The second is to use, especially in the Summer, Baths of sweet and scarce lukewarm Water, without any emollient Ingredients; such as Mallows, the Herb Mercury, Milk, &c. but rather a moderate proportion of new Whey, and Roses.

Casing the Body before Bathing.

5. But what we take for the Capital thing of all in this Intention, tho never mention'd till now, is, before Bathing, to anoint the Body with Oil, properly thickned like a Paint; that the coolness of the Water may be received, yet the Water itself kept off; tho without closing the Pores of the Body too much: for where external Cold shuts up the Body strongly, 'tis so far from procuring coolness, as rather to prevent it, and excite Heat.

The use of Bladders filled with cooling Liquors.

6. What bears some Analogy to this, is, the use of Bladders fill'd with refrigerating Decoctions and Juices, and applied to the lower Region of the Body, viz. the whole Abdomen; thus making a kind of Bath, where the Substance of the Liquor is excluded, and its coldness principally, or alone received.

7. The

7. The *third* Direction regards not the quality, but the substance of the Blood; with design to render it less dissipable, closer of Texture, and of such a Disposition, that the heat of the Spirit may the less affect it. *Condensing the Blood.*

8. And for the use of Gold, either in Leaf, or Filings; the Powder of Pearl, Coral, Gems and the like, we have no farther opinion thereof, than as they may possibly answer the present Intention: and surely since not only the *Arabians*, but also the *Greeks* and the Moderns have ascribed such great Virtues to these Medicines, there may seem to be somewhat in them, which so many Persons declare they have experienced. To drop, therefore, all fanciful Notions about them, we judge, that if there cou'd be some such thing convey'd into the whole Mass of Blood, and intimately mix'd therewith in the smallest Particles, whilst the Spirits and Heat might have little or no effect upon this Matter; it wou'd prevent, not only Putrefaction, but Dryness, and prove exceedingly efficacious in prolonging Life. But this Affair requires several Cautions; as (1.) That the Substance be ground extremely fine; (2.) That it be free from all Malignity, lest coming into the Veins, it shou'd do Mischief; (3.) That it be never taken at Meals, nor so as to lodge long by the way, for fear of producing dangerous Obstructions about the Mesentery; and (4.) That it be used but seldom, to prevent its clodding in the Veins. And therefore let it be taken in the Morning fasting, in a Glass of white Wine, mix'd with a little Oil of Almonds; and using some proper bodily Exercise upon it. *The introducing a fix'd and durable Substance into the Blood.*

9. The Simples best conducive to this Operation may be reduced to three, viz. Gold, Pearl, and Coral; for all the other Metals, except Gold, have some malignant quality in their volatile part; nor can they be so exquisitely ground as Leaf-gold. And for all the transparent Gems, they are but a kind of Glass; and therefore to be rejected for fear of wounding and tearing the finer Vessels. *The Simples best suited to the Intention.*

10. But, in our Judgment, it wou'd be safer, and more effectual to use Woods by way of Infusion or Decoction; as these may be sufficiently able to give strength and durability to the Blood, without the danger of causing Obstructions; especially as they may be taken along with the Diet, and thence be the easier received into the Veins, and not thrown off with the Fæces. *Woods preserved.*

11. The Woods proper for this purpose are Saunders, Oak, and the Vine; for we reject the hotter kinds, and such as are any way resinous. We might also add the dry and woody Stalks of Rosemary; this being a Shrub as durable as many Trees: and again the dry and woody Stalks of Ivy; to be used in such proportion as not to prove ungrateful to the Taste. *The sorts to be chose.*

12. Let these Woods be taken either boil'd in Broths, or steep'd in new Wine or Beer, before the Liquor grows fine. When used in Broths, let them be long infused before boiling, that the firmer part of the Wood, and not only that which sticks but loosely in it, may be drawn out. And so much for the operation upon the Blood. *How to be used.*

IV.

The History of the Operation upon the Juices of the Body.

Two kinds of durable Substances.

1. **W**E before observed, in our Enquiry into inanimate Bodies °, that there are two kinds of Substances which consume with difficulty; viz. hard and fat ones; as appears in Metals and Stones; Oil and Wax.

The Intention what.

2. The *Intention*, therefore, must be to render the Juices of the Body *hardish* and *unfluuous*.

Hardness how procurable to the Juices.

3. Hardness is procurable to them three ways; viz. (1.) By aliment of a firm Nature; (2.) By Cold, condensing the Skin and Flesh; and (3.) By Exercise, binding up and working the Juices together, or preventing them from growing soft and frothy.

The aliments to be chose.

4. The Aliment shou'd be of the most substantial or undissipable kind; as Beef, Pork, Venison, Goat, Kid, Swan, Goose, and Ring-dove; especially when moderately salted: again, salt and dry'd Fish, old Cheese, &c.

The Bread.

5. As to Bread; that of Oats, or with a little mixture of Pease, and that of Rye or Barley is more solid than that of Wheat; and of Wheat Bread, that is the more solid which has somewhat more of the Bran.

6. The Inhabitants of the *Orcades*, who feed upon salt Fish, and generally all Fish-eaters, are long lived.

7. The Monks and Hermites, who used a sparing and dry Diet, were also generally long lived.

The use of Water for Drink.

8. A free use of clear Water for Drink, renders the Juices of the Body less spumy; and because of the dulness of its Spirit, which doubtless in Water is not very penetrating, we judge it of use to dissolve a little *Nitre* therein. And so much for the *firmness of the aliment*.

Living in the cold Air.

9. (2.) As for condensing the Skin and Flesh by Cold; we find such Persons are generally longer lived, who live in the open Air, than those that live under Cover; and the Inhabitants of cold Countries longer lived than those of hot ones.

Hot Lying.

10. Too much Covering upon the Bed, and too much Clothing, soften and dissolve the Body.

Cold-Bathing.

11. Cold-Bathing is serviceable to prolong Life; but Warm-Bathing is prejudicial: and for Bathing in astringent mineral Springs, we have spoke of it above.

Exercise.

12. (3.) With regard to Exercise; an unactive Life manifestly renders the Flesh soft and dissipable; but robust Exercise, if without too much Sweat and Lassitude, hard and compact. Exercise also in cold Water, as that of swimming is very advantageous; and, in general, Exercise in the open Air, is better than under Cover.

13. But

° See Sect. I.

p Pag. 380. §. 9.

13. As for Frictions, tho' these are a Species of Exercise, yet as they rather call forth than indurate the Aliment, we shall not speak to them here, but hereafter. *Frictions.*

14. We come next to the Unctuousness or Roscidity of the Juices; which is a more perfect and powerful Intention than Induration; as having no inconvenience or mischievous Effect: for all those Things which tend to harden the Juices, at the same time that they prevent the wasting of the Aliment, also prevent its repair; and thence are both conducive to, and preventive of Long-Life; whilst that which regards the Roscidity of the Juices, proves advantageous in all Respects; as rendering at once the Aliment less dissipable, and more reparable. *The procuring of balsamick Juices.*

15. By saying that the Juices shou'd be roscid or unctuous, we mean not this of any manifest Fat; but only that a dewy, balmy, or, to use the vulgar Expression, a radical Moisture, shou'd be every way diffused thro' the Habit or Substance of the Body. *Roscidity of the Juices what.*

16. Nor again, let any one imagine that Oil, or fat Meats, or Marrow, beget these Juices, and so answer the present Intention; for whatever is once perfected, never goes its Course over again: but the Aliment ought to be such as, after Digestion and Maturation, at length produces a balminess in the Juices. *Roscidity not owing to Fat.*

17. Nor must it be imagined, that tho' simple Oil or Fat collected together, be of itself hard to dissipate; yet it assumes another Nature in mixture: for as Oil alone, wastes much slower than Water alone, so does it also hang longer in Paper or Cloth, and dries slower; as was observed above. *Fat not dissipable even in mixture.*

18. For spreading these roscid Juices thro' the Body, roasted or baked Meats are better disposed than boil'd; and all Preparations of Meat with Water are less proper: thus we see that Oil is yielded more copiously by dry Bodies than by moist ones. *Roasted Meats recommended.*

19. In general, the free use of sweet Things conduces to procure this Roscidity of the Juices; such as Sugar, Honey, sweet Almonds, Pine-apples, Pistachios, Dates, Raisins, Currans, Figs, &c. As on the contrary, all acid, over saline, and too acrimonious Things, are preventive thereof. *Sweet Things.*

20. Nor let us be thought to favour the *Manichees*, and their Diet, if we direct a frequent use of Seeds, Nuts, and Roots, in Meats or Sauces; since all Bread, which is the capital Food, is either made of Seeds or Roots.

21. But above all, the quality of Drinks is what most conduces to diffuse roscid Juices thro' the Body; as being the Vehicle of the Food: and therefore let the Drink turn upon such Liquors as are subtile, but without Acrimony or Acidity; viz. Wines which have lost their pungency; or, as the old Woman in *Plautus* expresses it, are grown *Toothless with Age* ^p. And the same is to be understood of Malt-Liquors. *Drinks.* *Mellow Wines.*

Mead.

22. We conceive that *Mead* would be a proper Liquor, if made strong and kept till it was old ; but since all Honey has some acid or sharp Parts, as appears from the corrosive Water which Chemists draw from it that even dissolves Metals, it were better to make a like Drink of Sugar ; not by a slight Infusion, but by a thorough Incorporation ; in the same manner as Honey is incorporated in *Mead* : and this should be kept for a Year, or six Months, before 'tis used ; whereby the Water employ'd in the Composition, may both lose its Crudity, and the Sugar acquire a Subtilty of Parts ¹.

The Acrimony
of Liquors cor-
rected.

23. Age, in fermented Liquors, has the property of procuring Subtilty in all the Parts, and Acrimony in the Spirit ; the former of which is beneficial, but the latter prejudicial : therefore, to remedy this undue Mixture, let a proper Portion of well-boil'd Venison, or Pork, be put into the Cask, before the Liquor is fallen fine, or whilst it continues new ; that the Spirit of the Liquor may have somewhat to feed and prey upon ; and thence deposite its Acrimony ².

The Drink of
Grain impro-
ved.

24. In like manner, a Drink brew'd, not entirely of Grain ; as malted Barley, Wheat, Oats, Pease, &c. but with the Addition of about a third part of Roots, or fat Pulps ; as Potatoes, Artichoke-bottoms, Burdock-roots, &c. we conceive would be more conducive to long Life, than a Drink prepared entirely of Grain.

Sauces, Pickles,
&c.

25. Again, such things as abound with very fine Parts, yet, without all Acrimony or Pungency, may be employ'd in the way of Sauce, Pickle, or Sallad : and this kind of Property we find in some few Flowers ; as those of Ivy ; which being pickled in Vinegar, are pleasant to the Taste ; those of Marigold, and those of Betony. And so much for the Operation upon the Juices of the Body.

V.

The History of the Operation of the Viscera ; for protruding the Aliment.

The Four grand
Viscera to be
assisted.

I. **T**HE Writings, Prescriptions, and Directions of Physicians, may shew what things assist the four principal Viscera ; (*viz.* the Stomach, the Liver, the Heart, the Brain ; which are the Seats of Concoction) in the due performing of their Functions ; whereby the Aliment is distributed into all the Parts, the Spirits sent out, and thence the repair of the whole Body secured.

Less Notice
here taken of
the secondary
Viscera.

2. We here speak not of the Spleen, the Gall, the Kidneys, the Mesentery, the Intestines, and the Lungs ; because these are Parts subservient to the principal ones : tho in a Discourse of Health and Diseases, they might sometimes be of capital Consideration ; as each of them has its particular Distempers, which, unless cured, affect also the principal Viscera. But with regard to the prolongation of Life, the repair by Alimentation, and retard-

ing.

¹ See the Article SUGAR, in the *Sylva Sylvarum*.

² See the Articles CLARIFICATION, DRINKS, &c. in the *Sylva Sylvarum*.

ing the Waste brought on by Old Age ; if the Concoctions and these principal *Viscera* are well secured, the rest, in great measure, proceeds successfully.

3. Every one must, for himself, collect such Particulars from the Writings of the Physicians that treat of comforting and preserving the four principal *Viscera*, as the Nature and Constitution of his Body requires ; and apply them in his Diet and Regimen of Life : for the preservation of Health generally requires only temporary Remedies ; but the prolongation of Life is to be endeavoured by a thorough Regimen, and a constant course of assisting Remedies : a few of the best whereof, selected with Choice, we shall here propose.

A Regimen to be formed for every Constitution.

4. The *Stomach*, which provides for all the other Parts, and whose Strength is fundamental to all the other Concoctions, should be so defended and secured as to remain moderately warm, constringed, clear, and unoppressed by nauseating Humours ; yet never entirely empty ; as being rather nourished by itself than by the Veins : and lastly, in good Appetite ; because Appetite promotes Digestion.

The Stomach, how provided for.

5. It seems strange, that the Practice of drinking Liquors hot, which prevailed among the Antients, should be grown into disuse. I remember a very eminent Physician that used, at Dinner and Supper, greedily to swallow down his Broth very hot ; and presently after to wish it up again, saying, *He did not want the Broth ; but only the Heat.* And indeed I conceive it useful, to take the first Glass of Liquor, whatever it be, always hot at Supper.

Hot Liquors recommended.

6. We likewise judge such Wine proper at Meals, wherein Gold has been quenched ; not as believing the Gold communicates any Virtue to the Wine ; but, as knowing that all Metals quenched in any Liquor, give it a powerful Astringency : and we make choice of Gold, because it leaves no other metallic Impression, besides the desired Astringency, behind.

Gold quenched in Wine.

7. Towards the middle of the Meal, we judge, that Bread dipped in Wine, is better than Wine itself ; especially if the Wine 'tis dipped in be first impregnated with Rosemary and Citron-peel ; and also sugar'd, to make it pass the slower.

Bread steeped in Wine.

8. The Use of Quinces is, by Experience, found to strengthen the Stomach ; but, in our Judgment, the clarified Juice made into a Marmalade, or Syrup, with Sugar, is preferable to the Flesh, or Pulp ; as it thus proves less oppressive to the Stomach : and the Marmalade eat by itself, after Meals, or along with Vinegar before them, is excellent.

Quinces.

9. The Simples best suited to the Stomach are *Rosemary, Ellicampane, Wormwood, Sage, and Mint.*

The best Simples for the Stomach.

10. We approve of Pills composed of *Aloes, Mastich, and Saffron*, taken before Dinner, especially in the Winter ; provided the Aloes be not only several times washed in the Juice of Roses, but also in Vinegar, wherein Gum Traganth is dissolved ; and afterwards steeped, for some Hours, in fresh drawn Oil of sweet Almonds, before 'tis made up into the Mass.

Pills.

11. Wormwood-Ale, or Wine, with a small addition of Ellicampane and yellow Saunders, is properly used at Intervals ; tho best in the Winter.

Medicated Drinks.

E e e 2

12. But

• See the Article MEDICINE, in the *Sylva Sylvarum*,

Medicated
Wines.

12. But in the Summer, a Glass of white Wine diluted with Strawberry-water; the Wine having first stood upon fine Powder of Pearls, Crawfish-shells, and (tho this may seem strange) a little Chalk; admirably strengthens and refreshes the Stomach.

Morning-
draughts.

13. But in general, all Morning-draughts of cooling Liquors, whether Juices, Decoctions, Whey, &c. are to be avoided; and nothing that is purely cold taken upon an empty Stomach. Such things are better used, if Occasion be, five Hours after Dinner; or an Hour after a light Breakfast.

Fasting.

14. Often fasting is prejudicial to long Life; and all Thirst must be avoided: the Stomach being kept sufficiently clean, but continually moist.

Unguents.

15. A little *Mithridate* being dissolved in fresh Oil-Olive, and rubbed upon the Spine, opposite to the Mouth of the Stomach, strangely cherishes and refreshes the Stomach.

Quills.

16. A little Bag filled, with fine teased Wooll, or scarlet Flox, and steeped in rough red Wine, impregnated with Myrtle, Citron-peel, and a little Saffron, may be constantly wore upon the Stomach. But enough of Remedies for comforting the Stomach; since many of those which answer the other *Intentions*, also conspire to answer this.

The Liver,
how to be re-
garded.

17. As to the *Liver*; if it be preserved from Dryness and Obstruction, it requires nothing more; for that Relaxation of it which produces Aquosities, is plainly a Disease: but the coming on of Old Age, also causes the other two. And this *Intention* is chiefly answered by the Remedies above set down, under the Operation upon the Blood: but we will here add a few more to them, selected with choice.

Pomgranate-
Wine.

18. Let a principal Use be made of the Wine of sweet Pomgranates, or, if that cannot be procured, of their Juice fresh express'd: to be taken in the Morning with a little Sugar, a Bit of fresh Citron-peel, and three or four whole Cloves, put into the Glass wherein the Juice is squeezed. And let this be continued from *February* to the end of *April*.

Cresses.

19. Before all other Herbs, let young Cresses be used; either in the way of Salad, in Broths, or in Drinks; and next to this Scurvy-grass.

Aloes:

20. Aloes, in what manner so ever washed, or corrected, is prejudicial to the Liver; and therefore never to be used common: but Rhubarb is sovereign to the Liver, if used with three Cautions; viz. (1.) If taken a little before Meals; to prevent its drying too much, or leaving a Stypticity behind: (2.) If it be steep'd for an Hour or two in fresh Oil of Almonds, along with Rose-water, before it be otherwise infused, or given in Substance: And, (3.) if taken alternately, one while simple, another while with Tartar, or a little Bay-salt; to prevent its carrying off only the finer Parts, and leaving the Mass of Humours more stubborn than before.

Chalybeates.

21. We judge it proper to take a Dose of Chalybeate Wine, or Decoction, three or four times a Year; to dissolve the more stubborn Obstructions; provided it be each time preceded by two or three Spoonfuls of new drawn Oil of sweet Almonds, and followed by due Motion of the Body; especially of the Arms and Belly.

22. Sweet Liquors, made with a Mixture of some fat Substance, have a *Sweet and* great and capital Efficacy to prevent Dryness, Parchedness, and Saltiness of *unctuous Li-* the Liver; and preserve it in a youthful State; especially if they are well *quors.* incorporated by Age. Thus, in particular, Wines and Drinks made of new Raisins, Jujubs, Figs, Dates, Parsnips, Pistachios, the bulbous Roots, as Potatoes, &c. sometimes with a Mixture of Liquorish; and again, Drinks made with Maiz, or *Indian* Corn, are of great service. And the *Intention* of preserving the Liver in a certain soft and balmy State, is of much greater Efficacy than that which regards the opening of it; which rather tends to Health than the prolongation of Life: only such Obstructions as cause Parchedness of the Liver, are as destructive as other kinds of Dryness.

23. The Roots of Succory, Spinage, and Beet, separated from their Pith, *Sauce,* and boiled tender in Water, with a third part of white Wine, are serviceably eat along with Oil and Vinegar, in the way of Sauce at Meals; so likewise are Asparagus, Artichoke-bottoms, and Burdock-roots, properly boiled, and served up in the same manner: and again, in the Spring-time, Pottage made with Vine-buds, and the green Blades of Wheat. And so much for preserving the Liver.

24. The *Heart* receives the greatest Relief and Prejudice, (1.) From the *The Heart,* Air we breathe; (2.) From Odours and Vapours; and, (3.) From the *how to be re-* Passions of the Mind. And, in this respect, many of the Particulars above *garded.* noted of the Spirits, may be applied here. But as for the indigested heap of Cordials, to be found among the Writers on Medicine, they are of little service in this *Intention*; only such as have an antidotal Virtue may be used, with Judgment and Discretion, for strengthening the powers of the Heart; especially such as do not so much oppose the peculiar Nature of Poisons, as fortify and preserve the Heart and Spirits against them. And for particular Cordials, the *Table* of them, above drawn up, may be consulted †.

25. A wholesome Air for Habitation, is better discovered by Experience *Wholesome* than by Signs: but we judge that of open Plains, or champaign Countries, *Air.* to be the best; where the Soil is dry, not parched or sandy, but spontaneously grows wild Thyme, and wild Marjoram; with up and down some Tufts or Sprinklings of Calamint; and which is not otherwise bare, but interspersed with Trees for Shade; and where also the Dog-rose smells somewhat aromatic. As for *Rivers*, we conceive them rather prejudicial; unless very small, clear, and gravelly-bottom'd.

26. 'Tis certain that the Morning Air is more vital and refreshing than *The Morning* that of the Evening; tho' the latter be coveted more thro' Delicacy. And *Air.* we judge the Air agitated with Breezes, to be more healthy than that which is serene and still. The western Breezes seem wholesomest in the Morning; but in the Afternoon the northern.

27. *Odours* are very effectual in reviving the Heart. But a good Odour is *Odours;* no property of a good Air; for some Airs are found to be perfectly pestilential, tho' of a less disagreeable Scent than others more in-
nocent;

† See Sect. VII.

nocent ; in like manner, conversely, there are wholesome Airs, and very agreeable to the Spirits, yet either absolutely inodorous, or less fragrant and grateful to the Sense. And those who live in a good Air, should only make use of Odours at certain Intervals ; because a continued Odour, tho ever so excellent, proves somewhat oppressive to the Spirits.

Those of growing Vegetables.

28. And for this purpose we recommend, before all others, the Odours of Plants and Vegetables, uncropt and growing, to be received in the open Air ; as from blooming Violets, Pinks, and July-flowers ; Bean-flowers, Lime-Tree-blossoms, Honey-suckles, yellow Wall-flower, Musk-roses, which yield their Smell more copiously on the Bush than other Roses ; dying Strawberry-beds, Sweet-briar, Calamint, Lavender in flower : and, in hot Countries, Oranges, Citrons, Myrtle, and Bays. And therefore to walk, or sit sometimes in the Atmospheres of these Vegetables, will be of Use.

Cooling Odours.

29. For recreating the Heart, we prefer cooling Odours to such as are heating ; and therefore recommend as excellent, and to be used in the Morning, or during the Noonday-heat, a certain Perfume or Vapour, made by throwing a Mixture of equal Parts of Vinegar, Rose-water, and good Wine, upon a hot Iron Plate. And the same Intention might be answered by pouring fragrant Wine into a Hole made in good fresh Earth, and stirring the moisten'd Mould about with a Spade. 'Tis likewise excellent, now and then, to smell at, or snuff up the Nostrils, Orange-flower-water, mix'd with a moderate proportion of Rose-water, and fragrant Wine.

Masticatories.

30. *Masticatories* held almost continually in the Mouth, composed of such things as cherish the Spirits, are exceeding useful. And to supply the Want of the famous *Indian Betel*, little Troches may be made of Orrice-root, *Lignum Aloes*, *Lignum Rhodium*, Roses, Musk, and Ambergrease ; the Mass being beat up with Rose-water, and a little *Indian Balsam*.

Vapours.

31. The *Vapours* arising from things taken internally, for strengthening and fortifying the Heart, should be *benign*, *clear*, and *cooling* ; for Heat in Vapours is bad : and Wine itself, tho thought to have only a heating Vapour, is not without some opiate Virtue. By *clear Vapours* we understand, such as have more of real or aqueous Vapour than of fume or exhalation ; without at all participating of smokiness, footiness, or greasiness ; but being purely moist and uniform.

Cordials for Diet.

32. From an unwieldy heap of *Cordials* we may select a few, fit to be made a part of Diet : and what may supply the place of all the rest, are, for the purpose of Warming ; Ambergrease, Saffron, and Kermes-berries ; and for cooling, the Roots of Bugloss, and Borage, as also Citrons, Lemmons, and Apples.

Gold and Bezoar.

33. We have, above, spoke of *Gold* and *Pearls*, which taken in the manner there prescribed, may, besides their Action in the finer Vessels, have also some Effect upon the *Viscera* in their Passage ; and cool without any noxious Quality. But for *Bezoar*, tho, by reason of the numerous Instances of its Virtues, we cannot wholly reject it ; yet doubtless its Preparations should be such as may make it easily impart its Virtue to the Spirits :

fo

so that we cannot approve of taking it in Broths, Syrups, Simple-waters, or the like; but rather in Wine, Cinnamon-water, or the like spirituous and distilled Liquors, tho not made hot and strong.

34. We have already spoke to the Passions of the Mind, and have only *Passions.* here to add, that all great, lasting, noble, or heroical Desires, strengthen and enlarge the Powers of the Heart.

35. With regard to the *Brain*, the Seat and Office of the animal Spirits, what we have above delivered of *Opium*, of *Nitre*, and their Substitutes, *The Brain, how to be regarded.* and again, of procuring quiet Sleep, have some right to this place also. And as 'tis certain that the *Brain* is under the Influence of the Stomach; what is before said of defending and preserving the Stomach, may likewise be understood of the Brain by consent. We shall, however, propose a few Remedies for the Brain in its own Particular; three of them external, and one internal.

36. And *first*, we recommend the Practice of Bathing the Feet, at least *Bathing the Feet.* once a Week; the Bath being prepared of a Decoction of Sage, Camomile, Fennel, sweet Marjoram, Costmary, the green Leaves of Angelica, and Bay-salt.

37. We likewise recommend a Suffumigation, or Fume, to be used every *Fumes.* Morning; the Ingredients thereof being dried Rosemary, dried Bay-twigs, and *Lignum Aloes*; omitting the sweet Gums, which oppress the Head.

38. Great care must be taken of applying hot things externally to the Head; as Spices, or even Nutmeg itself: such hot things are only fit for the *Hot things to be avoided.* Soles of the Feet, and should be no where else applied. Yet we recommend a gentle anointing of the Head with Oil, made by the Infusion of Roses and Myrtle; with the Addition of a little Salt and Saffron.

39. Considering what is above delivered of Opiates, *Nitre*, and the like, *Castor.* which greatly condense the Spirits; we judge it proper once in a Fortnight, to take three or four Grains of *Castor*, with a little *Angelica* Seed, and *Calamus Aromaticus*, in the Morning; for these Ingredients strengthen the Brain, and excite a Vivacity and Vigour in that density of Spirits, which is so necessary to long Life.

40. In these Methods of supporting the four principal *Viscera*, we have offered such things as are well adapted, culled out by a deliberate Choice, and capable of being brought into Diet and Regimen, with safety and convenience: for multiplicity of Medicines is the Child of Ignorance. Nor is it so certain, that many Dishes cause many Diseases; as that many Medicines perform few Cures. And so much for operating upon the principal *Viscera*, with regard to protruding the Aliment.

VI.

The History of the Operation upon the external Parts ; for attracting the Aliment.

The attractive Power of the external Parts to be excited.

1. **A**Ltho it be the capital thing towards a perfect Alimentation of the Body, to have Concoction well performed in the internal Parts ; yet the external also must contribute their Action ; that as the inward Faculty propels and sends out the Nutriment ; so the Faculty of the outward Parts may attract and lay hold of it : and the weaker the digestive Faculty proves, the more Occasion it has for the concurring Assistance of the attractive one.

This Attraction, how caused.

2. A powerful Attraction of the external Parts, is principally caused by the Motion of the Body ; whereby the Parts being heated and cherished, eagerly invite, and attract the Aliment to them.

The Caution is requires.

3. But great Care must be had, that the same Motion and Heat which call forth the new Juices to the Parts, do not at the same time too much rob those Parts of the Juices they were before supplied with.

Frictions.

4. *Frictions* highly conduce to answer this *Intention*, being used particularly in the Morning ; but this Operation should always be immediately succeeded by a slight Motion of the Body ; lest otherwise the Attrition should exhaust and dry up the external Parts, by making them perspire too much.

Exercise.

5. What approaches nearest to this is *Exercise*, by which the Parts mutually rub and chafe each other ; but it ought to be moderate, not too quick, nor above the Strength, or productive of Lassitude. And here, as well as in the case of Frictions, care must be had that the Body perspire not too much : and therefore Exercise is better in the open Air than under Cover ; and better in Winter than in Summer. But Exercise should not only, as well as Frictions, be succeeded, but also, when vehement, preceded by Unction ; in the manner of the antient Wrestlers.

To prevent its wasting the Spirits.

6. That *Exercise* may not too much consume the Spirits, or dissolve the Juices, 'tis best to be used upon a Stomach not quite empty : and therefore, that it may not be practised upon a full Stomach, which is very prejudicial to Health ; nor Fasting, which is very prejudicial to long Life ; a proper kind of Breakfast should be used, consisting both of Meat and Drink ; tho in a very moderate and sparing Quantity.

Exercises for spreading the Juices thro' the Body.

7. *Exercises* for distributing the Juices thro' the Body, should affect all the Limbs equally ; and not so as to move the Legs, and rest the Arms, &c. but so as that every Part may have its Share of Motion : and it greatly conduces to long Life, that the Body be never long kept in the same Posture ; but to change it at least every half Hour, except in Sleep.

The mortifying Regimen.

8. The things commonly used by way of Mortification, may be employ'd to prolong Life ; for Hair-shirts, Scourging, and all Severities used to the external Parts, increase their attractive Power.

9. *Cardan* recommends the external Application of stinging Nettles, even *Stinging Nettles.* in the case of Melancholy; but we have little certain Knowledge of their Efficacy: and suspect the Practice of giving some venomous Quality; as the Nettles, by frequent Use, may breed Exulcerations and tettery Humours in the Skin.

VII.

The History of the Operation upon the Food; so as to make it insinuate into the Parts of the Body.

1. **T**HE vulgar Censure of Luxury, or variety in Diet, becomes the Mouth of a Reformer better than of a Physician: an uniform, *A free Table to be used.* sparing Table may indeed somewhat prevent Interruptions in Health; but at the same time it is prejudicial to long Life; because a various and different Mixture of Aliment is better and quicker admitted and received into the Blood and Juices, than such as is simple and homogeneous. It has also a very great power to excite the Appetite; which is the Spur of Digestions. We therefore approve of a well furnish'd Table; and a frequent change of Dishes, according to the Seasons of the Year, or otherwise †.

2. So likewise, that Notion of a Simplicity of Meats, without Sauce, is but flashy and idle; for well chosen Sauces are the wholesomest preparations of Food, and contribute both to Health and long Life †. *Sauces to be allow'd.*

3. Care must be had to accompany Meats hard of Digestion, with stronger Liquors; and Sauces that penetrate and attenuate; but such as digest easily, with thinner Drinks and richer Sauce. *The Sauce and Drink to be suited to the Food.*

4. To the Direction lately given, for taking the first Glass of Liquor warm at Supper, we here add, that by way of preparing the Stomach, a good spiced Glass of the Liquor any one is most accusom'd to, should be taken warm, half an Hour before Meals. *Aromatic Liquors before Meals.*

5. A well regulated preparation, and dressing of Bread, Meats, and Drinks, directed with a View to the present *Intention*, is a thing of exceeding great moment; tho' it appear mechanical, or to smell of the Kitchen and the Cellar; and infinitely more useful than all the pompous, fabled Virtues of Gold, Gems, and Bezoar. *The due dressing and preparing of Meats.*

6. To think of moistening the Juices of the Body by a moist preparation of the Food, is childish; this may somewhat allay the heats of Distempers, *Dry dressing preferred.* but is directly opposite to the Nature of a balmy Nutriment; and therefore, for the present *Intention*, the boiling of Meats is by no means comparable to roasting, baking, and the like.

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F f f

7. Roast-

† Let due care be here taken to understand the Author justly; and the Grounds and Reasons whereon he founds this Judgment.

† Many Physicians seem to have introduced a kind of monastic Diet into Medicine. Let the Enquiry be duly prosecuted on both sides, before Judgment is pass'd.

*Roasting, how
best performed.*

7. Roasting should ever be performed quick, and with a brisk Fire ; for Meats are pall'd, and lose their nutritimental Parts, by delay, and continuing at a slow Fire.

*Meat to be
salted before
dressing.*

8. All the more solid Flesh-meats in use should not be dressed quite fresh ; but a little salted ; so as in great measure, or entirely, to prevent the Use of Salt at the Table : for Salt incorporated with the Food, is of more service in distributing the Nutriment, than when used loose.

*New Way of
preparing
Meats.*

9. There remain to be brought into Use, various proper Methods of macerating and steeping Flesh in convenient Liquors, before 'tis dressed ; like those sometimes practised in the pickling of certain Fish, and the preparing of Dishes for the Oven ^w.

*Stamping or
Bruising of
Flesh.*

10. The beating, bruising, or stamping of Flesh before 'tis dressed, is of singular service. Every one acknowledges, that Game taken by Hawking, or by Hunting, eats the finest ; unless where the Chase was too long continued : and certain Fish become much better Food by being whipt and beaten ; as hard and austere Fruits become sweet and soft by squeezing and pressure. But the best Preparation of all would be, to bring into Use a Method of bruising and stamping the harder kinds of Flesh before dressing.

*Bread, how
best prepared.*

11. Bread moderately leavened, and very little salted, is the best ; and should be baked in a sufficiently hot and quick Oven.

*Drinks for long
Life.*

12. All that regards the preparation of Drinks for long Life, may be nearly included under a single Precept. The Use of Water, as the only potable Liquor, may preserve Life for some time ; but, as we formerly observed, can never carry it to any great length. This needs no preparation. But for spirituous fermented Liquors, the capital and almost only Caution they require is, that their Parts be rendered exceeding subtile ; and their Spirit exceeding mild and gentle. Age alone can hardly procure this Effect ; for tho it renders the Parts somewhat more subtile, yet, at the same time, it renders the Spirits more acrimonious : and therefore we, before, gave Directions for steeping some fat Substance in the Cask ; to take off this acrimony of the Spirits. There is another Way of procuring the same Effect, without Infusion or Mixture ; viz. by keeping the Liquors in constant Agitation ; as, either by carrying them to Sea, continuing them upon Carriages at Land ; or suspending small Vessels by Ropes, and swinging them daily, &c. for 'tis certain that such local Motion attenuates their Parts ; and works the Spirits so much into them, that they cannot afterwards turn tart, or biting ^x.

*The Food,
how to be pre-
pared in Old
Age.*

13. In extreme Old-Age, the Food should be so prepared as to become a kind of half Chyle before 'tis used. But for Distillations of Meat, they are perfect Trifles ; as the nutritimental and best part of them, does not at all rise in Vapour.

*Meat and
Drink to be
previously
mixed.*

14. To incorporate Meat and Drink together, before it comes into the Stomach, is advancing it a degree towards Chyle ; and therefore, for
Example,

^w See the Author's *new Atlantis* ad finem. And his *Sylva Sylvarum*, under the Article FOODS.

^x See the *Sylva Sylvarum*, under the Articles CLARIFICATION, MATURATION, &c.

Example, let Chickens, Partridges, Pheasants, &c. be boiled in Water with a little Salt; then cleansed, made dry, and stamp'd; and afterwards put into new Wine, or Beer, whilst it is working, with the addition of a little Sugar.

15. Expressions also, and fine Choppings of Meats, well seasoned, are proper for Men grown very old; the rather, because they generally want Teeth to chew their Food; which is an extraordinary Method of preparing it. *Expressions and fine mincings of Meats.*

16. Three things may contribute to supply the defect of Teeth; viz. (1.) The Production of new ones; which seems extremely difficult, and not possible without an intimate and powerful Renovation of the whole Body. (2.) By hardening the Gums so, with the Use of proper Astringents, that they may in some measure perform the Office of Teeth; which seems not altogether impracticable. And, (3.) By preparing the Food in such a manner as not to require chewing; which is a ready and easy Method. *The want of Teeth, how remedied.*

17. With regard to the Quantity of Meat and Drink; some Excess in both is now and then convenient, for washing or over-flowing all the Parts of the Body; and therefore immoderate eating and drinking, at certain times, should not be absolutely prohibited. *Some Excess in Meats and Drinks allowable.*

VIII.

An Explanation of the Operation upon the last Act of assimilating the Food.

THERE needs no more than a short and simple Direction about the last Act of Assimilation; which is the thing intended by the three Operations immediately preceding: as this Affair rather requires Explanation, than any variety of Rules. *Transition.*

1. 'Tis certain, that all Bodies have some Appetite of assimilating, or turning into their own Substance, such things as are next them. This is done copiously and briskly by all subtile and pneumatical Bodies; as Flame, Air, and Spirits: and but very weakly by those of a gross, tangible Substance, which have their Appetite of Assimilation bound down, and restrained by a stronger Appetite of Rest, and avoiding of Motion. *All Bodies have an Appetite of assimilating.*

2. 'Tis likewise certain that this Appetite of Assimilation, which we observe to be kept under, and render'd unactive, in gross tangible Substances, is still animated, somewhat released, set free, excited, and at length actuated by Heat, or Spirit, coming in contact with them. And this is the only Reason why animate Bodies do, and inanimate Bodies do not assimilate. *This Appetite quickned by Heat.*

3. Again, 'tis certain that the harder the Consistence of a Body is, the greater Heat it requires to excite the Act of Assimilation; but in Old Age it happens, very disadvantageously, that all the Parts grow stubborn, and the Heat grows weak: and therefore this stubbornness of the Parts must be either mollified, or the Heat increased. But of malaxing the Parts we shall presently

The HISTORY of LIFE and DEATH.

presently speak, in particular; and have already proposed many Expedients for preventing their Hardness. And for the other *Intention*, of increasing Heat, we shall lay down a single Rule, upon the strength of the following AXIOM.

An AXIOM.

4. The Act of Assimilation, being excited by the Mediation of Heat, is an extremely subtle and intimate Motion, in the small Particles of the Matters concerned: but such Motions are in greatest Vigour when all local Motion ceases; which might otherwise disturb it. For the Motion of Separation into homogeneous Parts; as in Milk, where the Cream rises, and the thinner Parts subside; could never be effected if the Milk were kept, tho but in a gentle Agitation: nor will Water, or mixed Bodies, putrefy whilst they are continued in perpetual local Motion.

The Rule it affords.

5. As, therefore, the Act of Assimilation is principally performed in Sleep and Rest; especially towards the Morning, after the Distribution has been made of the Aliment; we can think of no other Rule to answer this Intention, than to sleep warm; and towards the Morning use such a kind of Motion, or put on such a prepared Linen Bed-gown, as may excite a moderate Heat; and upon this to sleep again *v.*

IX.

The History of the Operation for mollifying the Parts; when they begin to dry; or for suppling and malaxing the Body.

Transition.

HAVING already enquired into the internal Methods of suppling the Body, which proceed by many Windings and Turnings, in respect both of the Aliment and the Detention of the Spirits; and therefore necessarily operate but slow; we come next to enquire into the external and shorter ways of effecting the same Thing.

The Fable of Medea's Cauldron.

1. In the Fable of restoring *Pelias* to Youth, *Medea* preparing for the Operation, proposes to cut the old Man's Body to pieces; and then to boil it with certain Simples in a Cauldron. But tho, literally, some kind of Coction may be requisite in such an Intention; surely the Body need not be cut in pieces for it. And yet some kind of cutting seems necessary, tho not with a Knife, but the Judgment; for as there is a great difference between the Consistence of the *Viscera* and other Parts, they cannot all be mollified the same way; but regard must be had to each of them respectively; besides what belongs to the general Intention of suppling the whole Mass of the Body: of which in the first place.

Bathing and Anointing, to supple the Body in general.

2. And if the Thing be possible; Bathing, Anointing, and the like, may conduce thereto. But we must not fondly imagine it performable, from

v The AXIOM above laid down, and the Rule deduced from it, may afford us a little Specimen of the Method wherein the Author here endeavours, and directs all other Enquiries to proceed.

from what we see happen in the steeping and macerating of inanimate Bodies ; whereby they are rendred soft and tender, according to some Examples formerly produced : for this Operation is more facile upon inanimate Bodies, because they attract and suck in Fluids ; but more difficult in animal Bodies, because Motion in them tends rather from the Center to the Circumference.

3. And therefore, the common emollient Baths, in use, are of little Service, *The common Baths of little Service.* or rather opposite to this Intention ; as they rather extract than insinuate ; and rather loosen than confirm the Texture of the Body.

4. There are three Properties required in the Baths and Unctions design'd for this Operation, of duly and substantially supplying the Body. *The Baths. and Unguents required for the purpose.* (1.) The first principal Property is, that they consist of such Things, as in their whole Substance are similar to the Body, and the human Flesh ; and at the same time bland, and nourishing from without. (2.) That they have such Things mix'd with them, as by their subtilty of Parts may gain entrance ; and so convey and spread the nutritive Virtue of the other Ingredients along with themselves : and, (3.) That they receive some small mixture of such Things as are constringent, or strengthening ; not rough or austere, but balmy and cherishing ; so that whilst the other two perform their Operation, all Exhalation from the Body may, as much as possible, be prevented ; which might otherwise destroy the malaxing Virtue ; and rather that, by constringing the Skin, and closing up the Pores, the Motion towards the internal Parts may be assisted and promoted.

5. What approaches nearest to the substance of the human Body, is warm animal Blood ; but that Conceit of *Ficinus* for restoring strength to old Men, by sucking Blood from the Arm of a young one, is strangely empty : for what nourishes internally, ought by no means to be consubstantial or perfectly homogeneous with the Body to be nourish'd ; but of a somewhat lower and subordinate Class, that it may be converted : tho' for external Application, the more similar the Substance, the greater the Consent.

6. It was antiently believed, that a Bath of Childrens Blood wou'd cure the Leprosy, and restore corrupted Flesh ; insomuch that certain Kings have been envied by their Subjects for this Advantage. 'Tis related that *Heraclitus*, for a Dropsy, put himself into the warm Belly of an Ox, new kill'd : and the warm blood of Kittens has been used for the Erysipilas ; and for renewing the Flesh and the Skin. *Baths of Blood.*

7. In Amputations, or in great Hemorrhages of a Limb, 'tis of use to thrust the bleeding part, into the bleeding Body of a Beast new kill'd ; for this acts powerfully in stopping the Hemorrhage : the wounded part strongly attracting, and sucking to it, the warm Blood of the Creature, by consent ; thus causing a regurgitation, a stoppage of the Flux^a.

8. In dangerous and desperate Diseases, great use is made of live Pigeons, *Live Pigeons.* cut asunder, and applied, one after another, to the soles of the Feet ; and this some-

^a Is this certain ?

sometimes with wonderful Success; the cause whereof is vulgarly assign'd to their attracting the malignity of the Distemper: but, in some measure, the Remedy has an effect upon the Head, and relieves the animal Spirits. But as all these kinds of bathing the Parts, or besmearing them with Blood, appear to us filthy and disagreeable; we shou'd look out for others, which are less loathsome, yet full as serviceable.

*More agreeable
Methods.*

9. And next to recent Blood, the Things most similar to the substance of the human Body, are of the nutrimental Kind; as the well fed Flesh of Oxen; Swine, or Deer, Oysters, Milk, Butter, Eggs, Wheat-Flower, and sweet Wine, either sugar'd or mix'd with Honey.

*Salts to be ad-
ded.*

10. The Things to be mix'd along with others, for procuring Entrance and Admission, are Salts, especially Bay-salt: and these may be used instead of all the rest. Wine also, that is full of Spirit, proves a good Introducer, and is an useful Vehicle.

Constringents.

11. The Constringents, of the Character above required, are Saffron, Mastich, Myrrh, and Myrtle-berries; as being at once both unctuous and cherishing.

12. And out of these Ingredients, such a Bath, in our Judgment, may be made, as we at present desire. But Physicians, and Posterity, may find still better Expedients.

*A Course of
malaxing.*

13. This Operation may be render'd much more effectual, if such a Bath, which we conceive the principal Thing, be used; with the observance of these four Directions: (1.) That previous to bathing, the Body undergo Friction; and be afterwards anointed with Oil, made thick like Paint, that the moistening Heat and Virtue of the Bath may enter the Body, rather than the aqueous part of the Liquor. (2.) That the Bathing itself next ensue; and be continued for about two Hours. (3.) That after Bathing, the Body be coated over with a proper mixture of Mastich, Myrrh, Gum Tragacanth, Saffron and Diapalma; to keep in, as much as possible, the perspirable Matter, till the softening Matter be by degrees turn'd into a more solid Substance: and that this be continued for twenty four Hours or more. (4.) And lastly, That when this coating is taken off, the Body be anointed with Oil, whereto a little Salt and Saffron is added; the Bathing being repeated four Days afterwards, with the other parts of the Process, as before; and the Course continued for a Month.

*The Regimen
during the
Course.*

14. During this Course of mollifying, we judge it useful, proper, and suitable to the Intention, that the Body be well fed; kept from the cold Air; and receive nothing in the way of Drink, without warming. But this Course is one of those Things which we have not experienced; only set it down as what promises to answer the end: for having marked out the Road, we deliver the *traditory or illuminating Lamp* into other Hands^b.

*The Applica-
tion of live
Bodies.*

15. Nor ought the warm and cherishing Applications, of the Bodies of living Creatures, to be omitted. *Ficinus*, without intending a Jest, said, that *David* might have had comfortable use of *Abisbag's* lying on his Bosom, had

^b See the de Augment. Scientiar. Pag. 147.

had she not come too late. He shou'd have added, that, after the manner of the *Persian Virgins*, she ought to have been perfum'd with Myrrh, and other Ingredients; not to please the more, but to increase the cherishing Virtue expected from the warmth of her Body.

16. *Barbarossa*, in extreme old Age, had, by the Advice of a *Jewish Physician*, young Boys continually applied to his Bosom; in order to warm, cherish and preserve him: and some old Men accustom themselves to apply young Puppies, which is a very hot kind of Creature, to their Stomach at Nights.

17. There goes a Report, not unsupported in many respects, that certain Persons of monstrous Noses, have had the exuberant Parts and Bunches thereof pared down; and the Nose trim'd to a moderate size; then making an Incision in the fleshy part of the Arm, they have held the trim'd Nose therein for a time, and thence procured it handsome. If this account be true, it affords a remarkable Instance of the consent between Flesh and Flesh; especially whilst alive.

18. It wou'd be too tedious to enquire after, and prescribe Rules for, mollifying all the principal Viscera; as the Stomach, the Lungs, the Liver, the Heart, the Brain, the spinal Marrow, the Kidneys, the Gall-Bladder, the Intestines, Veins, Arteries, Nerves, Cartilages and Bones; as we are not now writing a Practice, but only setting down Indications for it.

The Enquiry for mollifying the Viscera not prosecuted.

X.

The History of the Operation for discharging the old Juices, and supplying their Place with New; or the Business of Periodical Renovation.

THO what we shall deliver upon this Head, has in great measure been touch'd already; yet because the Operation is capital, we will here treat the former matters again, with a more express View to it.

Transition.

1. 'Tis certain that draught-Oxen, worn down with Labour, being put into fresh Pasture, recover tender and young Flesh; as we find by eating of it: whence it manifestly appears no difficult thing to procure tenderness to the Flesh. And 'tis likewise probable, that if the Flesh be thus several times made tender, the Effect may reach to the Bones, Membranes and the like.

Tender Flesh procurable.

2. 'Tis certain, that the usual Courses of Diet Drinks, consisting principally of Guaiacum, as also of *Sarsa*, *China* and *Sassafras*; especially when long continued, and according to strict Rules; first attenuate, and then consume and waste the whole Mass of Juices; as plainly appears from hence, that they actually cure the Venereal Disease, even tho' grown so inveterate as to produce

Diet-drinks discharge the old and procure new Juices.

^c See the *Chirurgical Operations of Taliacotius*.

produce Nodes in the Bones; and corrupt and deprave the innermost Fluids of the Body: and again, because the Persons who are render'd extremely lean, pale, and almost cadaverous by such kind of Diet-drinks, presently afterwards grow fat, fresh coloured, and are manifestly renewed. And therefore we judge that such a Course wou'd be extremely serviceable to the present Intention; being used once in two Years, in the decline of Age; and prove like casting the Skin to the Snake; or procure a kind of Rejuvenescency.

*'Advantage of
familiar Purg-
ing.*

3. And we are firmly persuaded, that repeated and familiar Purgings has a much greater power to prolong Life, than Exercise and Sweating. This must be the Case, if the former Position be true; that anointing the Body; blocking up the Pores from without; excluding the Air; and keeping the Spirits from exhaling greatly conduce to Longevity. For 'tis certain, that Sweating and Perspiration, not only evaporate and consume the superfluous and excrementitious Humours and Vapours; but with them also the good Juices and Spirits, which are not so easily repaired: whereas the contrary happens in Purgings, unless very immoderate; as this operates principally upon the excrementitious Humours. But the best Purges for the Intention, are those taken before Meals; because they thus dry the Body less: and therefore ought to be composed of such Simples, as give little disorder to the Stomach.

*Conclusion of
the preceding
Enquiry.*

4. The Intentions of the Operations here proposed, we conceive to be just; and the Remedies prescribed, very suitable to them. And tho many of them may seem trifling and vulgar, yet a Man would scarce believe with what degree of Care and Choice we have sat upon and examined them; that they might be not only well adapted, but safe and effectual. Experience, however, is what must prove, and carry this matter still farther. In all Cases, the Results of deliberate and prudent Consideration, tho ever so admirable in their Effects, and excellent in their Order; constantly appear but vulgar and obvious Things when discover'd.

S E C T.

SECT. IX.

The HISTORY of the AVENUES, or last Approaches of Death; in prosecution of the fifteenth Article of the Table of Enquiry.

WE come next to enquire into the *Avenues of Death*; that is, into what happens a little before, a little after, and at the very instant a Person dies: for as there are many Ways which lead to Death, we shou'd understand in what common Roads they terminate; especially in such Deaths as are occasion'd by the Impoverishment of Nature, rather than by Violence; tho' some regard must also be had occasionally to the latter, by reason of the Connection that one thing has with another.

1. There seem three Requisites to the subsistence of a *living Spirit*; viz. (1.) A commodious Motion. (2.) A temperate Coolness, or Refreshment: and (3.) A proper Aliment. Flame appears to require but two of these; viz. Motion and Aliment: for Flame is a simple, but Spirit a compound Substance; which is destroy'd by approaching near to the Nature of Flame.

Transition.

Three requisites in a living Spirit.

2. (1.) A less Flame is deaden'd, extinguish'd, and destroy'd, by a greater and more powerful one, acting upon it; and the same holds yet stronger of *Spirits*.

3. Flame is extinguish'd by too great a Compression; as we see by inverting a Glass upon a Candle: nor will Fire burn in a Grate, when the fuel is press'd too close; without leaving some space between its Parts.

Relation of Flame and Spirit.

4. Ignited Bodies are likewise extinguish'd by Compression: thus a red hot Coal is presently put out, by strongly compressing it with a Fire-shovel, or the Foot.

5. But with regard to the Spirits; if any Blood or ferous Matter gets into the Ventricles of the Brain, 'tis sudden Death.

Sudden Deaths caused by Extravasations, Contusions.

6. So likewise, great Contusions of the Head cause sudden Death; by compressing the Spirits in the Ventricles of the Brain.

7. Opium, and other strong Narcoticks coagulate the Spirits; and deprive them of Motion.

Opium.

8. Poisonous Vapours, which are utterly abominated by the Spirits, also cause sudden Death; as we see in those kinds of deadly Poisons that operate by what they call a specifick Malignity: for these give such an abhorrence to the Spirits, as to deprive them of Motion; or disable them from striving against a Thing so contrary to their Nature.

Poisons.

Drunkennes.

9. So again, great fits of Drunkennes, Surfeiting and Gluttony, sometimes cause sudden Death; in which Cases, the Spirits are not so much oppress'd by the density or malignity of the Vapour, (as in Opium, and malignant Poisons) as by its quantity.

Fear and Sadness.

10. So likewise extreme Fear and Sadness, especially when sudden; as upon hearing an unexpected Disaster; sometimes occasion sudden Death.

Great Dilatations of the Spirits.

11. And not only too great a Compression; but also too great a Dilatation of the Spirits proves mortal.

Sudden Joy.

12. Great and sudden Joys have frequently proved mortal.

Large Evacuations.

13. Large Evacuations, as upon tapping for the Dropsy, when the Water comes away in abundance; but more particularly great and sudden Hemorrhages, are often followed by sudden Death. And this seems to happen by the way of preventing a vacuity in the Body; whilst all the Fluids plentifully pour themselves out, to fill up the emptied Spaces; and among the rest the Spirits themselves. And thus much for the Motion of the Spirits, compress'd or discharged, so far as to cause Death.

Suffocation.

14. (2.) We next proceed to the *want of Coolness*. Stoppage of the Breath proves suddenly mortal; as in all Suffocation and Strangulation. And this does not seem owing, so much to the prevention of Motion, as to the prevention of Cooling; because Air when too hot, tho' largely taken in, suffocates no less than a Stoppage of Respiration; as happens in such as are sometimes suffocated by going into close Rooms, where Charcoal Fires have been kept for airing them, or drying the Walls, that were newly plaister'd, or white-washed: which is a kind of Death said to have befallen the Emperor *Jovinian*°. And the like happens in *Bagnios*, or dry Bathings, when the Hot-room is over heated: which was a Thing practis'd in the Death of *Fausla*, Wife to *Constantine* the Great.

The Motion of Respiration.

15. 'Tis a very short time wherein Nature performs the Act of Respiration; or discharges the Air received into, and spoiled by the Lungs: as desiring to take in fresh at least twenty times in a Minute.

The Pulse.

16. The pulsation of the Arteries, and the *Systole* and the *Diastole* of the Heart, is a Motion three times quicker than that of Respiration; whence if it were possible to stop this Motion of the Heart, without altering that of Respiration, a more sudden Death wou'd ensue than by Strangulation.

Force of Custom in Respiration.

17. But Use and Custom have a considerable Force in this natural Action of Respiration; as appears, from the *Delian* Divers, and Fishers for Pearl; who by constant Practice can hold their Breath, at least ten times longer than other Men.

Respiration different in different Creatures.

18. There are some Animals, among such as have Lungs, that can hold their Breath for a longer, and others for a shorter time; as they require a greater, or less degree of Coolness, or Refreshment.

19. Fish

° Several of later Date have suffer'd this kind of Death; by entering suddenly into Rooms kept close, with Charcoal Fires in them,

19. Fish require less cooling than Land Animals ; tho they still require some, and are refreshed by their Gills : and as Land Animals endure not a close and over sultry Air ; so Fishes likewise are suffocated, when the surface of the Water remains for a long time entirely frozen. *Fish how refreshed.*

20. If the Spirits be attack'd by any Heat, much greater than the natural, they are thereby dissipated and destroy'd : for if they cannot sustain their own native Heat, without being cool'd and refresh'd ; much less can they endure a foreign one, that is more intense ; as appears in burning Fevers, where the Heat of the corrupted Juices exceeds the natural Heat ; so far as to dissipate and consume the Spirits. *Heat destructive to the Spirits.*

21. The want and enjoyment of Sleep has also some Relation to this Refreshment : for as Motion attenuates and rarifies the Spirits, and thereby provokes and increases their Heat ; so Sleep, on the contrary, appeases and quells their Motion, and Disorder. For tho Sleep strengthens, and promotes the Actions of the less lively Parts and Spirits, and all Motion to the Circumference of the Body ; yet it in great measure calms and dulls the proper Motion of the living Spirit. But Men regularly require Sleep once in four and twenty Hours ; and of five or six Hours continuance at least ; tho there are sometimes found Miracles of Nature in this Respect. Thus 'tis reported of *Mecanas*, that he slept not for a long time before his Death. And so much for the want of Coolness, requisite to the preservation of the Spirits. *Refreshment by Sleep.*

22. (3.) The third Requisite, that of *Aliment*, seems to regard the Parts, rather than the living Spirit : For it is easily believed, that the living Spirit remains identically the same ; without Succession or Renovation : but for the rational Soul, 'tis certain that this comes not by Propagation ; and neither suffers Death nor Repair. Men likewise talk of a natural Spirit, both in Animals and Vegetables ; which differs as well essentially as formally, from the other ; and from confounding these two together have proceeded the Doctrine of Transmigration ; and numberless other false and fictitious Notions, among the Hereticks and the Heathens. *Alimentation of the Parts.*

23. The Body in Health, regularly requires a diurnal Renovation by Aliment ; and can scarce, without detriment, suffer three Days fasting : tho Use and Custom may make great Alterations in this respect. But Want is easier endured in a languishing Illness. And Sleep in some measure supplies the place of Aliment : as Exercise, on the contrary, requires it more. There are some, however, tho few, who have been found, in a very extraordinary manner, to live a considerable time without Meat or Drink. *The Necessity of eating.*

24. Dead Bodies, if not prevented by Putrefaction, continue long without any considerable waste ; but living ones, as we before observed, not much above three Days, unless recruited by Aliment : which indicates that quick Consumption to be the effect of the living Spirit, whilst it either thus repairs itself, or puts the Parts into a Necessity of repairing themselves, or both. And this seems confirm'd by the preceding Observation, that Animals can somewhat longer endure the want of Aliment, by the use of

Sleep: but Sleep is no more than the Collection of the living Spirit into itself.

*How large
Bleedings prove
mortal.*

25. A too large and continued Effusion of Blood; as sometimes happens from the Hemorrhoides; sometimes by Vomit, when certain internal Veins are burst, or their Mouths open'd; and sometimes by Wounds; causes sudden Death: the venal Blood supplying the arterial; and the arterial supplying the Spirits.

*More taken in
than discharg-
ed in a visible
Form.*

26. 'Tis a considerable quantity of Meat and Drink that a Man, by two Meals a Day, receives into his Body; and much more than he discharges by Stool, by Urine, and by Sweat. If this be not thought strange; as supposing that the other part may be changed into the Juices of the Body; yet let it be considered that this Supply, tho' afforded twice a Day, does not overload the Body; and again, that altho' the Spirits are recruited; yet these also do not immoderately increase in quantity^f.

*The waste of
old Age whence.*

27. 'Tis of no service to have Aliment present, only in a remote Degree; for it must necessarily be of such a kind, so prepared, and so applied, as that the Spirits may act upon it. Thus a Taper wou'd not continue flaming, unless immediately fed with Wax: nor can a Man be well nourished by Herbage alone. And herein consists the waste of old Age; viz. that tho' there be no want of Flesh and Blood, yet the Spirits are prepared in such a small and scanty Proportion, and the Blood and Juices are grown so exhausted, dry and balmless, that they cannot supply the demands of Alimentation.

*The Requisites
to Life sum'd
up.*

28. Let us now sum up the Requisites to Life, according to the common and ordinary course of Nature. (1.) The Spirits continually require, an expansive Motion in the Nerves and Ventricles of the Brain. (2.) The pulsation of the Heart, is required sixty times in a Minute. (3.) Respiration, twenty times in a Minute. (4.) Sleep and Aliment, once in three Days. And, (5.) A Power of Alimentation, suppose after eighty Years of Age. And if any of these Requisites are wanting, Death ensues. But there seem to be three more certain and evident *Avenues of Death*; viz. (1.) Want of Motion in the Spirits. (2.) Want of Coolness, or Ventilation. And, (3.) Want of Aliment.

Admonitions.

(1.) 'Tis an Error to imagine, that a living Spirit should be perpetually generated and extinguished, like Flame; without being able to last for some considerable Time. Even Flame itself is not thus generated, of its own Nature; but only because it acts among things that are not favourable to it; for one Flame is durable in another: but the living Spirit resides among things that greatly affect and delight it; and therefore, as Flame is a momentary, and Air a permanent Substance, the living Spirit seems to be of a middle Nature between both.

(2.) We observed at first setting out, that the present Enquiry was not concerned with the decay of the Spirits, occasioned by the destruction of the

^f This leads up to the Doctrine of insensible Perspiration.

the Organs, thro' Distempers and Violence ; tho this also terminates in the same three Avenues. And thus much for the *Form and Nature of Death.*

28. There are two grand *Harbingers of Death* ; the one detached from the Head, the other from the Heart ; viz. *Convulsions*, and a *labouring Pulse* : for the mortal *Hiccup* is a kind of Convulsion. And the mortal *labouring of the Pulse* has a remarkable Quickness ; the Heart trembling towards the Article of Death ; and almost confounding its *Systole* and *Diastole*. This *dying Pulse* is also attended with a Debility and Lowness ; and frequently a great intermission of the Stroke : the Motion of the Heart then failing ; or being no longer able to rise with strength and regularity.

29. Death is likewise preceded, and denoted near at hand, by great Inquietude and tossing of the Body ; a catching, unsteady Motion of the Fingers, as if to take up somewhat from the Bed-cloths ; grasping hard, and holding strong with the Hands ; grinding of the Teeth ; a hollow Voice ; trembling of the Under-jaw ; paleness of the Face ; confusion of the Memory ; loss of Speech ; cold Sweats ; shooting out of the Body in length ; turning up of the Whites of the Eyes ; an alteration of the whole Countenance ; or a pinching in of the Nose ; hollowness of the Eyes ; sinking of the Cheeks ; contraction and rolling of the Tongue ; coldness in the extreme Parts ; sometimes a discharge of Blood, &c. Shrieking, Gasping, and fetching the Breath thick ; falling of the Lower-jaw, and the like.

30. Upon Death their follows a deprivation of all Sense and Motion, as well of the Heart and Arteries as of the Nerves and Limbs ; an inability of the Body to sustain itself erect ; a stiffness and coldness of the Parts ; a loss of Colour ; and, some time after, Putrefaction and Stench.

31. Eels, Serpents, and Insects, continue to move in all their Parts, a long time after being cut asunder. Birds, likewise, flutter for a while after their Heads are struck off ; and the Hearts of Animals will long continue to beat, after being separated from their Bodies. I remember myself to have seen a Man quartered and disbowelled, for Treason ; when his Heart being thrown into the Fire, it sprung upwards ; first to the height of about a Foot and a half, and then by degrees a less height, for the space, as I judge, of two or three Minutes. There goes an ancient, and no improbable Tradition of an Ox, that lowed when his Entrails were taken out. Yet this appears less certain than what is related of a Traitor, who was heard to pronounce three or four Words of Prayer, after his Heart was separated from the Body, and remained in the Hand of the Executioner. We judge this Relation more credible than the former, of the Ox's lowing under the Hands of the Sacrificer ; because the Friends of the Persons publicly executed, usually Fee the Executioner, to perform his Office with the utmost expedition, and not keep the Malefactor long under Torture : whereas there appears no reason why the like Dispatch should be made in the case of Sacrifices.

32. The following things are in use for recovering Persons from Apoplexies and Faintings ; many of whom, without Relief, might die in the Fit ; viz. the exhibiting of spirituous Cordial-waters ; bending the Body for-
wards ;

wards ; stopping and strongly compressing the Mouth and Nostrils ; bending the Fingers, backward, so as to give Pain ; twitching off some Hairs of the Head or Beard ; rubbing the Parts, especially the Face and Extremities, briskly ; the quick sprinkling of cold Water upon the Face ; sudden and shrill Noises ; the applying of Rose-water and Vinegar to the Nose, in case of Fainting ; and burning Feathers or woollen Cloth under it, in hysterick Fits : but principally, the application of a heated Salamander, Shovel, or Warming-pan Bottom, near the Head, is serviceable in Fits of the Apoplexy.

Persons supposed dead, have recovered,

33. There are many Examples of Men left for dead, laid out, and even buried, who have yet come to life again. This has been discovered, in such as were buried, upon opening the Ground soon after, and finding Bruises and Wounds on the Head ; from the struggling of the Body in the Coffin. We had a late and very memorable Example of this, in the Person of that subtil Schoolman *Johannes Scotus* ; who being buried in the absence of his Servant, that seemed to have known him subject to such kind of Trances ; this Servant, some time after, opened the Grave, and found the Body bruised and wounded. The like happened in our Time, in the Person of a Player buried at *Cambridge*. And a certain Gentleman once told me, that having a desire to know what Hanging was ; he, by way of Curiosity, and without any ill Design upon himself, resolved to make some trial of it ; and to this purpose suspending a Cord, and fastening it about his Neck, he mounted a Stool, and swung himself off ; conceiving it in his power to recover the Stool again, when he pleased : but he failed in his Expectation ; and was relieved by the assistance of a Friend then present. Being asked, what he underwent in that Condition ? he answered, he felt no Pain ; but first perceived a kind of Fire, and burning before his Eyes ; then an extreme Blackness, or Darkeness ; and lastly, a kind of pale, blue, or sea-green Colour ; which is also frequently perceived by Persons in fainting Fits. And a Physician assured me, that by the use of Frictions, and hot Bathing, he had brought a Man to Life again, who hanged himself, and had continued hanging for half an Hour. This Physician farther declared, that he made no question of recovering any Person hanged up for the same time ; provided his Neck were not broken by the fall, or stretch of the Rope.

* The Instances of this kind should be carefully collected ; in order to gain as much light as possible into the Transaction at the Point of Death.

S E C T. X.

Of the Differences between YOUTH and OLD-AGE ;
with regard to the sixteenth Article of the Table of
Enquiry.

1. **T**HIS Scale, or Progression, of human Life is this: Conception ; *The natural*
Quickening ; Birth ; Lactation ; Weaning ; Feeding by Hand ; *Progress of*
Dentition, for the first time, at about two Years old ; Beginning to walk ; *Life.*
Beginning to speak ; Dentition the second time, at about the Age of seven ;
Puberty about twelve or fourteen ; Capacity for Generation ; The menstrual
Flux ; The growth of Hair upon the Legs and Arms ; Signs of a Beard ;
Growth of Stature to this State, and sometimes longer ; Perfection of
Strength, and Agility of Body ; Greynefs and Baldnefs ; Cessation of the
Menstrua, and power of Generation ; decrepid Age ; Walking with a Stick ;
Death. The Mind likewise has its several Periods, tho incapable of being
described by the numeration of Years ; such as decay of Memory, &c. of
which more presently.
2. The Differences between Youth and Age are these. *Youth and Age*
In Youth the Skin is smooth and equal ; but in Old-Age, dry and *compared.*
wrinkled ; especially about the Eyes and Forehead.
In Youth the Flesh is soft and tender ; but in Old-Age hard and dry.
Young Men are strong and healthy ; but old ones weaker, and slow of
Motion.
In Youth the Concoctions are well performed ; but in Old-Age weakly.
In Youth the *Viscera* are soft and succulent ; but in Old-Age dry and
parched.
In Youth the Body is strait and upright ; but in Old-Age bent, or curved.
In Youth the Limbs are firm and steady ; but in Old-Age, relaxed and
trembling.
In Youth the Humours are bilious, and the Blood is hot ; but in Age the
Humours are aqueous and melancholick ; and the Blood is colder.
In Youth there is a ready disposition to Venery ; but in Old-Age, a
slower.
In Youth the Juices of the Body are more balmy ; but in Age more
crude, and watery.
In Youth the Spirit is copious and turgid ; but in Old-Age poor and
little.
In Youth the Spirit is dense and fresh ; in Old-Age more rarified, and
eager.
In Youth the Senses are entire and lively ; but in Age dull and faulty.
In Youth the Teeth are strong and sound ; but in Age worn and decay'd.

In

In Youth the Hair is always coloured ; but in Old-Age, grey or white.

Youth is attended with Hair on the Head ; but Old-Age, with Baldness.

In Youth the Pulse is strong and quick ; but in Old-Age fainter and slower.

In Youth Diseases are more acute and curable ; but in Old-Age more chronical, and harder of cure.

In Youth Wounds heal faster ; but in Old-Age slower.

In Youth the Cheeks are florid ; but in Old-Age pale, or of a deep red, by reason of the Blood thickening and settling in them.

Catarrhs are less frequent in Youth ; but more troublesome in Old-Age.

Nor can we recollect in what respect Old-Age improves the Body ; unless sometimes in Corpulency : the reason whereof is obvious ; because the Body in Old-Age neither perspires freely, nor assimilates kindly ; whilst Fat is nothing but a redundancy of the Aliment, over and above what is discharged, or perfectly assimilated. Sometimes also there is an increase of Appetite in Old-Age, thro' the acidity of the Juices : for old Men do not digest well. But Physicians lightly attribute all the Particulars above-mentioned, to the diminution of natural Heat and radical Moisture ; which is an empty Notion, of no Use at all. Thus much is certain, that in declining Age, Coldness precedes Dryness ; and that the Body, when in the highest pitch and perfection of its Heat, declines to Dryness ; whilst Coldness succeeds afterwards.

*The difference
of Affections
betwixt Old
and Young.*

3. We are next to consider the Affections and Dispositions of the Mind. When I was a young Man, at *Poitiers* in *France*, I familiarly conversed with a young Gentleman of that Country, who was extremely ingenious, but somewhat talkative : he afterwards became a Person of great eminence. This Gentleman used to inveigh against the Manners of old People ; and would say, that if one could see their Minds, as well as their Bodies, their Minds would appear as deformed as their Bodies : and, indulging his own Humour, he pretended that the defects of old Mens Minds, in some measure, corresponded to the defects of their Bodies. Thus, Dryness of the Skin, he said, was answered by Impudence ; Hardness of the *Viscera*, by Relentlessness ; Blear-eyes, by Envy and an evil Eye ; their Down-look and Incurvation of the Body, by Atheism ; as no longer, says he, looking up to Heaven ; the trembling and shaking of the Limbs, by Unsteadiness and Inconstancy ; the bending of their Fingers, as to lay hold of something, by Rapacity and Avarice ; the Weakness of their Knees, by Fearfulness ; their Wrinkles, by indirect Dealings and Cunning, &c.

But, to be serious, young Men are modest and bashful ; old ones, not so tender of Countenance.

Young Men are generous and commiserating ; but old ones close, and harder of Heart.

Young Men have a laudable Emulation ; but old ones an ill-natured Envy.

Young Men are inclined to Religion and Devotion ; as being warm in themselves, and unexperienced in Misfortunes ; but old ones grow colder
in

in Piety, thro' want of Charity, a long conversation with Evils, and a hardness of Belief.

Young Men are resolute ; old Men more moderate.

Young Men have a certain Levity and Instability ; old ones a greater Gravity and Constancy.

Young Men are liberal, beneficent, and Lovers of their Species ; old ones are covetous, wise for themselves, and firm to their own Interest.

Young Men are full of Hope and Confidence ; but old Men diffident, and in most cases distrustful.

Young Men have an easy and obliging Carriage ; but old Men are churlish, peevish, and disdainful.

Young Men are sincere, and speak their Minds ; but old Men are cautious and reserved.

Young Men affect great Undertakings ; but old ones take care of such Things as are necessary.

Young Men favour Things present ; but old ones rather affect former Transactions.

Young Men reverence their Superiors ; but old Men censure them.

There are numerous other Differences, which belong rather to Morality than the present Enquiry. Yet as old Mens Bodies improve in some respects, so likewise do their Minds ; unless quite worn out : for Example, tho they are less ready at Invention, they are stronger in Judgment ; and chuse such things as are safe and solid, before such as are specious and showy. They likewise improve in Talkativeness, and the Art of shewing themselves to advantage ; and, becoming now unfit for Business, reap the fruits of Discourse : whence the Poets aptly feigned the Transformation of *Tithonus* into a Grass-hopper.

S E C T. XI.

Improveable A X I O M S, or Variable C A N O N S, formed upon the preceding History ; for giving Light into the Cause of the Continuance or Duration of L I F E, and the true Nature, or Form, of D E A T H ^h.

A X I O M I.

There is no Consumption, unless what is lost by one Body passes into another.

E X P L A N A T I O N.

Waste, how caused, and prevented.

T H E R E is no such thing as Annihilation in Nature ; and therefore in all Consumption, the Parts consumed either fly off into the Air, or are received into some adjacent Body. Thus we see Spiders, Flies, Ants, &c. included, and eternized in Monuments of Amber ; tho these are tender and dissipable Bodies : but then there is no Air in contact with them, for their Parts to escape into ; and the Substance of the Amber is so heterogeneous as to receive none of them. And the like Effect, we judge, might be procured by burying Wood, or the like, in Quicksilver : but Wax, Honey, and Gums, have this Effect only in part ⁱ.

A X I O M II.

All tangible Bodies contain a Spirit, covered over, and inveloped with the grosser Body ; and this Spirit it is that gives Origin to Consumption and Dissolution.

E X P L A N A T I O N.

Spirit the cause of Waste and Dissolution.

T H E R E is no known Body, in the upper parts of the Earth, without its Spirit ; whether it be generated by the attenuating and concocting Power of the celestial Warmth, or otherwise : for the Pores of tangible Bodies

^h This Section contains a kind of Recapitulation, or concise Abridgment, of the preceding History ; drawn up with new Enforcements, and set in a fuller light ; whence a Judgment may be the readier form'd thereof And certainly it must be a pregnant History, to afford such a number of Axioms, that seem a little Compendium of *Natural Philosophy* ; at the same time that they unfold, and explain, some of the great Mysteries of Life and Death. And hence also a tolerable Judgment may be formed of the Design of the *Sixth Part* of the *INSTAURATION*, which was to receive a Collection of still more perfect Axioms, after they had been thoroughly verified, or render'd precisely just ; at least so just as not to fail in Practice.

ⁱ These Axioms require a considerable Attention to perceive their full Meaning and just Value ; a greater to improve and verify them, where they may require it ; and a greater still

Bodies are not a *Vacuum*; but either contain Air, or the peculiar Spirit of the Substance. And this Spirit is not a Virtue, an Energy, a Soul, or a Fiction; but a real, subtle, and invisible Body, circumscribed by Place and Dimension. Nor again is this Spirit Air, any more than the Juice of the Grape is Water; but a fine attenuated Body, of kin to Air, tho' again, very different from it: for the grosser Parts of the Subject being of a sluggish and not very moveable Nature, would endure to a long Period, did not this Spirit rouse, stimulate, undermine them, and prey upon the moisture of the Body, and whatever else it can digest and convert into new Spirit; till at length, both the Spirit before included in the Body, and that newly formed, gradually fly away together. This is excellently demonstrated from the Diminution of the Weight of dry Bodies, thro' Perspiration: for all that which flies away, was not Spirit at the time of weighing the Body; but was Spirit when it flew off^k.

A X I O M III.

The Avolation of the Spirit of Bodies causes Dryness; but whilst this Spirit is detained and operates within, it either dissolves, putrefies, or vivifies the Body.

E X P L A N A T I O N.

THERE are four Processes of the Spirit; viz. (1.) that of Drying; (2.) that of Dissolving; (4.) that of Putrefying; and, (4.) that of Generating Bodies. *Four Operations of the Spirit; viz.*

(1.) *Arefaction* is not the proper Operation of the Spirit; but of the grosser Parts, after the Spirit is discharged: for upon this they contract themselves, partly to fill up Vacuities; and partly thro' an Appetite which homogenous Bodies have to unite; as appears in all Bodies dried by Age, and in the firmer Bodies which are dried by Fire; as Bread, Charcoal, Bricks, &c. *Arefaction.*

(2.) But *Colliquation* is a mere Work of the Spirits; and not performed without the Animation of Heat; whereby the Spirits dilate themselves, yet without flying off; and insinuate and spread among the grosser Parts; thus rendering them soft and fusible; as we see in Metals and Wax: for Metals, and other tenacious Bodies, are fitted to hold in the Spirit; and to prevent its Avolation when excited. *Colliquation.*

H h h 2

(3.) *Putre-*

still to explain them so as to render them universally intelligible; and draw them out into familiar Rules of Practice, for operating effectually in the grand Design of prolonging Life.

^k This Instance we meet with in Nuts, the Stones of Fruit, &c. where the Kernel dries and withers, as the Spirit perspires thro' the Shell and outward Coats; without the entrance or admission of the external Air. This Axiom relating to the Spirits of Bodies deserves a particular regard. And let not any modern Discoveries be too rashly imagined to have set the Doctrine of Spirits aside; whereon, perhaps, the Improvement of natural Philosophy principally depends. See the *Sylva Sylvarum*, under the Articles NATURE, SPIRIT, SYMPATHY, &c.

Putrefaction.

(3.) *Putrefaction* is a mixed operation of the Spirit, and grosser Parts; for when the Spirit, which restrained and held the parts of a Body together, is partly discharged and partly render'd languid, all things are dissolved, and return to their heterogeneous Principles; for now the Spirit contained in the Body gathers to itself; the oily Parts to themselves; the aqueous also to themselves; and the Fæces to themselves; upon which necessarily ensues that cadaverous Odour, that unctuousity, sliminess, and confusion of Parts observable in Putrefaction¹.

And Generation.

(4.) *Generation* likewise, or Vivification, is a mixed Operation of the Spirits and grosser Parts; but in a quite different manner: for in this case the Spirit is totally held in, (but still expands and moves itself,) whilst the grosser Parts are not dissolved, but obey the motion of the Spirit; whereby they are swelled, and thrust out into various Figures: whence proceeds Generation and Organization. And, therefore, Vivification is always wrought upon a tenacious, viscous Matter, tho soft and yielding; fit at once to detain the Spirit, and yet gently yield thereto; as the Spirit forms its Parts. And this appears in the Matter of all Vegetables and Animals, whether generated in Putrefaction, or from Seed; in all which there manifestly appears a Substance which is hard to separate, but easy to yield.

A X I O M IV.

All animate Bodies have two kinds of Spirits; viz. a lifeless Spirit, such as resides in Bodies inanimate; and a vital Spirit, superadded to it.

E X P L A N A T I O N.

The Two Spirits in Bodies.

1. **W**E formerly observed, that in order to procure long Life, the human Body should first be considered as a Body inanimate, and unrepairable by Aliment; and again, as a Body reparable and nourishable: for the former Consideration supplies the *Laws of Consumption*; and the second the *Laws of Repair*. We are, therefore, to understand, that all the parts of the Body, the Flesh, the Bones, the Membranes, the Organs, &c. have each of them, whilst alive, such Spirits diffused thro' their Substance, as are proper to them respectively, when separated, and dead, and such as remain even in the Carcass: but the *vital Spirit*, tho it presides over, and has a certain agreement with them, is yet a very different thing; as being entire, and subsisting of itself.

The Differences betwixt the lifeless and the vital Spirits.

2. There are two principal Differences betwixt the *lifeless* and the *vital Spirits*; the one, that the lifeless Spirits are not continued in themselves, but in a manner cut off and surrounded by the gross Body that intercepts them; like Air mixed in among Snow or Froth: but all the vital Spirit is continued

¹ See the Nature of Putrefaction, in the *Philosophical Transactions*; or *Boerhaave's Chemistry*, Process 88.

tinued in itself, thro' certain Canals, which it penetrates without being totally intercepted. And this Spirit also is of two kinds; the one only branch-^{Two kinds of vital Spirit.} ing out, and striking thro' little Tubes, and, as it were, single Threads: but the other has also certain Cells; so as not only to be continued with itself, but likewise copiously collected, in proportion to the Body, into Cavities which serve as Fountains to numerous Rivulets running from them. The principal Cells, or Cavities, of this kind, are seated in the Ventricles of the Brain; which in the more ignoble Creatures are narrow; so that their Spirit seems diffused over the whole Body, rather than contained in Cells; as appears in Serpents, Eels, and Flies, which, when cut to pieces, long continue moving in all the separated Parts: even Birds continue struggling for a while, after their Heads are off; because they have little Heads, and little Cells of Spirits. But the more noble Animals have these Ventricles still larger; and Man the largest of all.

3. The other Difference between the Spirits is, that the *vital Spirit* has ^{A second Difference between the Spirits.} some kind of Inflammability, and resembles a Breath composed of *Flame* and *Air*; as the Juices of Animals contain both Oil and Water. And this kind of Inflammability is attended with peculiar Properties and Motions; for even inflammable Smoke is warm, subtil, and moveable, before it catches Fire, and turns to Flame; yet becomes a different thing when changed to Flame. But the kindling of the vital Spirits is, by many degrees, more gentle than the softest Flame, even that of Spirit of Wine: and is also largely mixed with an aerial Substance, so as to become a peculiar and almost inexplicable Union, of a flamy and aerial Nature.

A X I O M V.

All the parts of the Body have their proper and respective natural Actions; but each of them is excited and quickened by the vital Spirit.

E X P L A N A T I O N.

THE Actions or Functions of any Part are correspondent to the Nature ^{The Office of the vital Spirit.} of that Part; such as Attraction, Retention, Digestion, Assimilation, Separation, Excretion, Perspiration; and even the Senses themselves, according to the Properties of every Organ; as the Stomach, Heart, Spleen, Brain, Ear, Eye, &c. Nor could any of these Actions be excited and performed without the animating Vigour and Presence of the vital Spirit, and its Heat; no more than one piece of Iron could attract another, unless first animated by the Loadstone; or an Egg produce a Chick, unless the Substance of the Hen were first actuated by the treading of the Cock.

A X I O M

Let these Axioms and Explanations by no means be lightly censured, and rejected as conjectural things; they are meant to be deduced from the preceding History, in the strict and genuine way of interpreting Nature.

The HISTORY of LIFE and DEATH.

A X I O M VI.

The lifeless Spirits are nearly of the same Substance with Air ; but the vital Spirits approach nearer to the Substance of Flame.

E X P L A N A T I O N.

The Substance of the Spirits.

THE Explanation of the preceding fourth *Axiom*, is also explanatory of this. But hence it is, that all fat and oily Substances continue long in their own State ; as the Air does not greatly operate upon them, nor they themselves greatly incline to mix with the Air. But that is an empty Conceit which supposes Flame to be kindled Air ; for Flame and Air are as heterogeneous as Oil and Water. The Sense of the present *Axiom* therefore is, that the vital Spirits only approach nearer to the Substance of Flame than the lifeless Spirits do ; and not that they are more of a flamy than aerial Nature.

A X I O M VII.

Spirit has two Appetites ; the one an Appetite of multiplying itself ; the other an Appetite of quitting the Body, and associating with Substances of its own Nature.

E X P L A N A T I O N.

The two Appetites of the Spirits.

1. THIS *Axiom* is understood of the lifeless Spirits ; for as to the second Appetite, the vital Spirit has a great abhorrence of quitting the Body ; nor can it find Substances of its own Nature near at hand : it may sometimes perhaps rush to the extremities of the Body, to meet a thing it affects ; tho it is averse to going out. But both these Appetites reign in the lifeless Spirits. As for the first ; no Spirit is commodiously lodged among gross Bodies ; and therefore when it finds nothing of its own Nature, it labours so much the more, in this Solitude, to multiply itself, or to create, or produce its like ; and thus briskly preys upon the more subtil Parts of the gross Bodies, in order to increase its own Quantity.

2. As to the *second* Appetite ; that of Escaping, and flying off into the Air ; 'tis certain, that all attenuated Bodies, which are ever moveable, willingly move to their like, when near adjoining ; as Flame, to Flame ; and one Bubble of Water to another : but this happens much more in the Avolation of the Spirits into the external Air ; as not tending only to Particles of a like Nature ; but, as it were, to an Ocean of matter homogeneous to itself. Let it however be observed, that the exit and escape of the Spirit into the Air is a double Action ; proceeding partly from the Appetite of the Spirit, and partly from the Appetite of the Air : for the common

common Air is a hungry thing; and greedily drinks in and receives Spirits, Odours, Rays of Light, Sounds, &c.

A X I O M VIII.

When a Spirit is detained, and finds no possibility of producing more Spirit; it mollifies even the grosser Parts.

E X P L A N A T I O N.

NEW Spirits are only produced upon such things, as approach, in a tolerable degree, to Spirit; as humid Bodies do: and therefore if the grosser Parts, wherein the Spirit lodged, are far removed from this degree; tho the Spirit cannot work, and convert them into its own Nature, still it saps, softens, and resolves them; and tho it cannot thus increase its own Quantity, yet it resides therein more loosely, and lodges among such Parts as are most favourable to it. And this *Axiom* is extremely conducive to our purpose; as leading to a Method of mollifying the stubborn and dry Parts of the Body, by keeping in the Spirits ^{*The Method of mollifying the harden'd Parts.*}.

A X I O M IX.

The Business of softening the harder Parts, is best carried on, when the Spirit neither flies off nor begets a new Supply.

THIS *Axiom* solves the Difficulty in the Operation of malaxing, by detaining the Spirit; for if the Spirit, being detained, should prey upon all within, there is no Advantage procured by suppling the Parts in their Substance; but they are rather dissolved and corrupted thereby: and therefore, besides detaining the Spirits, they must also be cooled, and constringed, to prevent their too great Activity. ^{*The Business of Malaxing, how best performed.*}

A X I O M X.

The Heat of the Spirit, for preserving the Body in a fresh and youthful State, ought to be robust; but not sharp, or predatory.

E X P L A N A T I O N.

THIS Canon also has a Tendency to solve the Difficulty above mention'd; but is also of much more extensive Use; as describing what ought to be the temper of Heat in the Body, to dispose it for long Life. And this ^{*The Heat required for preserving the Body young.*} temper

^a Observe, all along, that Practice is the End at which the whole Enquiry, and these *Axioms* drive.

The HISTORY of LIFE and DEATH.

temper of Heat is proper, whether the Spirits be kept in or not : for in either Case their Heat shou'd be such, as may rather act upon the Solids, than prey upon the Fluids ; as the former mollifies, but the latter dries up. The same Temper, also, is of Service in the due performance of Alimentation ; as such a Heat best excites the Faculty of assimilating ; and at the same time excellently prepares the matter for Assimilation. The Properties required in this Heat are ; (1.) That it be slow, and do not act of a sudden ; (2.) That it be not intense, but moderate ; (3.) That it be equable, not acting unsteddily, or by fits of Increase and Decrease ; and (4.) If it find any Resistance, that it shou'd not easily grow languid, or become extinct. This is an Operation of great Subtility, and of no less Use : We have therefore had a regard to it ; and hope, in some measure, to have answered the Intention, by the Remedies, above proposed, for giving the Spirits this robust, unconsuming and effective Heat.

A X I O M XI.

A Condensation in the Substance of the Spirits, is conducive to long Life.

E X P L A N A T I O N.

A Condensation of the Spirits required to long Life.

THIS *Axiom* is subservient to the former ; as a dense Spirit admits all the four Properties of Heat there mentioned. But for the ways of condensing the Spirits, we have described them above, under the first of the ten Operations.

A X I O M XII.

When the Spirits are copious, they hasten to escape faster, and prey upon the Body, more, than when their quantity is small.

E X P L A N A T I O N.

THIS *Axiom* is clear of itself ; since quantity, of course, increases Efficacy. And we see in Flames, that a greater breaks out more forcibly, and consumes its Fuel swifter than a small one : and, therefore an over Proportion, or Redundancy of Spirits, is very prejudicial to long Life. Nor shou'd a larger quantity of Spirits be desired, than may support the Offices of Life ; and secure a good Repair.

A X I O M XIII.

A Spirit equally diffused thro' the Body, hastens less to escape, and consumes the Body slower, than when unequally distributed.

E X P L A N A T I O N.

NOT only an over-Proportion of the Spirits, with regard to the whole, shortens the duration of Things ; but also the same quantity less ground or broken : and therefore the more the Spirit is comminuted, and dispersed thro' the finer Vessels and Fibres ; the less it consumes. For Resolution and Decay always begin in the part, where the Spirit is weak or wanting ; and therefore Exercise and Frictions contribute much to long Life. For all Motion and Agitation excellently grind, and intimately mix Things together in their smallest Particles.

A X I O M XIV.

An irregular and subsultory Motion of the Spirits, tends more to their escape, and proves more consuming, than a Motion that is constant and equable.

E X P L A N A T I O N.

THIS Axiom holds with certainty in Bodies inanimate ; for unequability is the Parent of Dissolution : but in animate Bodies it holds less strictly ; because in these, there is not only a Consumption, but a Repair to be consider'd : and Repair depends upon the Appetite of Things ; and Appetite is sharpen'd by Variety. But here also the Axiom may be admitted so far, that this Variety should rather be a regular Interchange than a Confusion ; and as it were a constant Inconstancy.

A X I O M XV.

The Spirit is detain'd in Bodies of a firm and close Texture, tho' unwillingly.

E X P L A N A T I O N.

ALL Things dread a Solution of their Continuity ; tho' this according to their degree of Condensation or Rarefaction : for the more Bodies are rarefied, the lesser Pores they will pass, or be driven thro', by Compression. Hence Water and Air will enter where Dust will not ; and

Flame and Spirit, where Air and Water will not. But this matter is limited ; for Spirit has not so strong an Appetite of escaping, as to suffer too great a discontinuation ; or be driven thro' Pores that are too close and strait : and therefore if Spirit be lodged in a hard Body, or such an one as is unctuous, and viscous, that will not easily separate ; 'tis then withheld, imprison'd, and exerts not its Appetite of escaping. Whence we see that Metals and Stones will not, for a very long time, let go their Spirit ; unless it be either excited by Fire ; or the grosser Parts of those Bodies be separated, and disjoint'd, by corrosive Liquors. And the like holds of tenacious Bodies, such as Gums ; only these are dissolved by a gentler Heat. And therefore, robust Juices of the Body, a constringed Skin, and the like, (which are procured by a drying Aliment, Exercise and cold Air,) prove serviceable in prolonging Life ; by shutting up the Pores upon the Spirit, and preventing its escape.

A X I O M XVI.

The Spirit is willingly detain'd in fat and unctuous Bodies ; tho they be not viscous.

E X P L A N A T I O N.

The Spirit willingly resides in Fat.

IF the Spirit be neither irritated by any Antipathy it has to the Body that surrounds it ; nor fed by too great a similitude with the Subject itself ; nor solicited by any thing external ; it becomes not very tumultuary to get out : but *oily Bodies* want all these Properties ; as being not so opposite to the Spirit, as hard Bodies are ; nor having such an Affinity thereto, as aqueous ones have ; nor greatly agreeing with the external Air °.

A X I O M XVII.

Oily Bodies are long preserved in a State of Perfection, by a quick discharge of their aqueous Moisture.

E X P L A N A T I O N.

A Discharge of aqueous Moisture tends to preservation.

WE just now observed, that aqueous Moisture, as approaching nearer to the Substance of the Air, flies off faster than such as is oily ; which has a less agreement with the Air : but as both these Moistures are lodged in most Bodies, it happens that the aqueous betrays the oily Moisture ;

° It may be well worth considering how extensive this *Axiom* is ; and how it agrees with the ancient and later Discoveries, as to the native Spirits of Bodies. See, in particular, the Processes upon Vegetables, in *Bouhaave's Chemistry*. See also Process 128.

sture ; and gradually escaping, carries that away along with itself : whence nothing is more conducive to the preservation of Bodies than to dry them gently ; which breathes out the watry Parts, without disturbing or affecting the oily. And this not only tends to prevent Corruption ; as it does by Consequence ; but also to preserve Bodies in a fresh and vigorous State. And hence it is, that gentle Frictions, and moderate Exercise, used so as to promote Perspiration rather than Sweat, greatly conduce to prolong Life.

A X I O M XVIII.

To exclude the Air from the Body, contributes to Longevity ; if other Inconveniences be prevented.

E X P L A N A T I O N.

WE lately observed ^p, that the escape of the Spirit is a double Action. *Exclusion of the Air tends to lengthen Life.* arising from an Appetite both of the Air, and Spirit ; it is therefore of considerable Service, if one of these Appetites can be destroy'd. This is chiefly to be expected from Unctions : but the Use thereof is attended with various Inconveniences ; which we have endeavour'd to prevent under the *second* of our *ten Operations*.

A X I O M XIX.

By introducing juvenile Spirits into an old Body, the Course of Nature may be expeditiously put back.

E X P L A N A T I O N.

THE Spirits are like the Master-wheel, that carries the other Wheels round in the Body : and therefore these ought to stand first in the Intention of prolonging Life. We may add, that there is an easier and more compendious way of altering the Spirits than the other Parts : for the Operation upon the Spirits is of two Kinds ; the one by Aliment, which is slow, and effected by a Circuit ; the other by Vapours, which is sudden, and reaches the Spirits directly and immediately. To this also may be added, the way of operating by the Affections, or Passions of the Mind. *An Intimation of a short Method of prolonging Life.*

A X I O M XX.

Hardness or Firmness, and Roscidity or Balminess, in the Juices of the Body, contribute to prolong Life.

E X P L A N A T I O N.

*Balmy Juices
to be procured.*

THE Reason hereof is plain ; since, as we have above observed, hard or firm, and balmy or unctuous Bodies, are dissipated with difficulty. There is however this Difference, that tho' hardish and firm Juices are less dissippable, they are at the same time less reparable ; which adds an Inconvenience to a Convenience ; and therefore nothing extraordinary can be perform'd by means of hard Juices : but a balmy Juice will answer both Intentions ; and therefore great regard must be had to the procuring of it.

A X I O M XXI.

Balmy Juices are procured by such Things as penetrate, thro' their subtilty or fineness of Parts ; yet corrode not by their Acrimony.

E X P L A N A T I O N.

*The Means of
procuring
them.*

THIS Axiom, or the Canon it affords, is easier to understand than to practise : for 'tis plain, that whatever penetrates kindly, but at the same time has a stimulating Virtue or Pungency, (which is the Case of all acid and biting Things,) leave, wherever they pass, some Impression of Dryness, or Corrosion ; so as to indurate the Juices, and vellicate the Parts : whereas, such as penetrate by mere Subtilty, steal in and insinuate themselves, without Violence ; whilst they moisten and bedew the Parts in their Passage. And some such Remedies as these, we have described under the fourth and seventh of our ten Operations.

A X I O M XXII.

Assimilation is best perform'd upon the Cessation of the Local Motion.

E X P L A N A T I O N.

THIS Axiom stands sufficiently explain'd by what is delivered under our eighth Operation.

A X I O M

A X I O M XXIII.

External Alimentation, at least such as is not perform'd by the Stomach, if it cou'd be procured, wou'd prove very serviceable in prolonging Life.

E X P L A N A T I O N.

WE see that every Thing perform'd by Nutrition, is perform'd by long Circuits; but much quicker by the way of imbibing a similar Substance, as in the Case of Infusions: a Method, therefore, of Alimentation from without, wou'd be extremely useful; the rather because the digesting Faculties fall off, and fail in Old-Age. Whence if there cou'd be any auxiliary ways of Nutrition contrived, by bathing, anointing, or by Glysters; they might prove serviceable, by a proper Conjunction of some of them, which separate wou'd be of less Significance.

A Method of external Alimentation.

A X I O M XXIV.

Where Concoction is weak, so as not to protrude the Aliment, the external Parts shou'd be excited; in order to attract the Aliment outwards.

E X P L A N A T I O N.

THE Sense of this Axiom is not the same with that immediately foregoing; for 'tis one Thing to attract the Aliment inwards, and another to draw it from within outwards: tho they both agree, in supplying the weakness of the internal Concoctions another way.

Concoction how to be strengthen'd.

A X I O M XXV.

All quick Renovation of the Body, is procured either by the Spirits, or by Malaxing.

E X P L A N A T I O N.

THE Body consists of two Things; Spirits and tangible Parts; both which are but slowly reach'd by Nutrition: whilst the short way to the Spirits is by Vapours, and the Passions of the Mind; and to the Parts, by suppling and mollifying Applications. But we must well distinguish between Alimentation by external Means, and malaxing: for the Intention of malaxing is not to nourish the Parts; but only the better to prepare them for being nourish'd.

Quick Renovation how procured.

A X I O M

A X I O M XXVI.

Malaxing is perform'd by Substances similar to the Body; Substances that insinuate into it; and Substances that close it up.

E X P L A N A T I O N.

*Malaxing how
to be perform-
ed.*

TIS evident, that similar Substances to the Body, are properly mollifying; whilst such as easily insinuate, help others forward; and such as close up or constringe, help to keep in and prevent Perspiration, which is a Motion opposite to Malaxing. This Operation, therefore, cannot be well perform'd at once; but shou'd be attempted in a Series and Method: (1.) By excluding the Liquor externally applied for the purpose, in the way of coating the Body over with some thick unctuous Matter: because all extraneous and gross Immersion, as in common Bathing, does not well consolidate the Body; but what is design'd to enter it, shou'd be subtiler, and a kind of Vapour; according to the Observation deliver'd in our *ninth Operation*. (2.) By mollifying, thro' a Consent of Substances of like kind: for Bodies open themselves, and relax their Pores, when they come in Contact with Things very agreeable to them. (3.) By using proper insinuating matters as Vehicles, that in some measure may convey and carry forwards the Substances of like Nature with the Body: These Vehicles also being lightly impregnated with gentle Constringents, that at the same time may a little check and prevent Perspiration. And, (4.) By following these Operations with a great Astringent, or shutting up of the Pores, by an emplastick Coating; and afterwards gradually by anointing; till the mollifying Matter acquires some degree of Solidity.

A X I O M XXVII.

A frequent renovation of the reparable Parts, renews also the Parts that are less reparable.

E X P L A N A T I O N.

*The old Parts
how to be re-
new'd.*

WE observed, in our general *Introduction* to this History, that in the natural Progress of Death, the more reparable Parts perish in the Embraces of the Parts less reparable; and that the utmost Efforts were to be used for repairing these less reparable Parts. Admonish'd, therefore, by the Observation of *Aristotle* upon Plants, where he says that the shooting out of new Branches causes also a renewal of the Trunk, by the Passage of the new Juices thro' it; we judge the Case might be the same, if the Blood and Flesh of the human Body were frequently renewed; and that the Membranes and other Parts, even the Bones themselves, tho less reparable in their

their own Nature, might be refresh'd, recruited and renew'd; partly by a brisk Passage and Circulation of new Juices in them; and partly again by the new Clothing, of recent Flesh and Blood, brought upon them.

A X I O M XXVIII.

That kind of Cooling, which does not pass by the Stomach, is conducive to long Life.

E X P L A N A T I O N.

THE Reason is obvious; as not a temperate, but a powerful degree of Coolness, especially in the Blood, is a principal Requisite to long Life: which Coolness cannot be procured in the necessary degree, by any Thing taken at the Mouth; without Prejudice, and Destruction, to the Stomach and Viscera. *The Cooling conducive to long Life.*

A X I O M XXIX.

This Complication, that both Consumption and Repair are the Operations of Heat, is the greatest Obstacle to long Life.

E X P L A N A T I O N.

MOST great Works are prevented or destroy'd by complicated Nature; what proves serviceable in some Respects, proving prejudicial in others: so that a consummate Judgment, and a discreet Practice, are here required. This we have, so far as the Subject allows, and our present Thoughts can reach, endeavoured after; and done our utmost to separate the benign and favourable Heats from such as are unkindly or hurtful; and given our Directions and Cautions with regard to both.^a *The great Obstacle to long Life.*

A X I O M XXX.

The Cure of Diseases requires temporary Medicines; but long Life can only be expected from a Regimen and Diet.

E X P L A N A T I O N.

THOSE Things that happen by accident cease upon removal of their Causes; but the Course of Nature is a continued Thing, which, like a rapid River, requires to be continually rowed against: whence to prolong Life, we must work regularly by a Regimen. *Regimens* are of two Kinds; *The Regimen required to prolong Life.*
(1.) *Statistical*

^a See above, Operation 2, 3, 9, &c.

The HISTORY of LIFE and DEATH.

(1.) *Stated* ; or to be observed at certain times ; and (2.) *Familiar* ; which shou'd be brought into daily Use. But *stated Regimens*, or a series of Remedies continued for a Season, are the most powerful. For Things, of that Efficacy as to turn Nature back in her Course, must generally be stronger and productive of more sudden Alterations, than those that can, with safety, be brought into frequent and familiar Use. Our *Intentional Remedies* turn but upon three stated Regimens ; viz. (1.) The opiate Regimen ; (2.) The malaxing Regimen ; and (3.) The discharging, and renovating Regimen. Among the most effectual Things prescribed, in our familiar and daily Regimen, and which almost equal the force of stated Regimens ; are (1.) Nitre and its Substitutes ; (2.) The Government of the Passions, and regulating the kinds of Study ; (3.) Methods of Cooling, that pass not by the Stomach ; (4.) Balmy Drinks ; (5.) The impregnation of the Blood with a firm Substance, as that of Pearls or Woods ; (6.) Proper Unguents to exclude the Air, and keep in the Spirits ; (7.) Proper external Methods of heating, during the time of Assimilation, after Sleep ; (8.) A cautious Use of such Things as inflame the Spirits, and give them a sharp consuming Heat ; for Example, Wines and Spices ; and, (9.) A moderate and seasonable Use of such Things as give a robust Heat to the Spirits ; for Example, Saffron, Cresses, Garlick, Ellicampane, and compound Opiates.

A X I O M XXXI.

Flame is a momentary Substance ; Air a fixed Substance : but the vital Spirits of Animals, is a middle Substance, betwixt both.

E X P L A N A T I O N.

*The Relation
betwixt Flame,
Air, and vital
Spirit.*

THIS is a matter of deep Enquiry ; and requires a larger Explanation than belongs to the present Subject. Let it be observed, however, that Flame is continually generating and dying : so as to exist only in Succession. But Air is a permanent Body that does not perish ; for altho new Air be generated from aqueous Moisture, yet the old Air still remains : whence proceeds a Surcharge of Air*. The vital Spirit participates of both Natures ; and is at once flamy and aerial. And accordingly its Pabulum or Fuel, are Oil and Air ; the Oil being homogeneous with Flame, and the Air with Water : for Spirit is not fed, or nourished by Oil alone, or by Water alone ; but by both. And tho Air neither comports well with Flame, nor Oil with Water ; yet they suit in Mixture or Composition. Again, Spirit has its ready and delicate Impressions from the Air ; but its noble, powerful, and active Motions from Flame. So, likewise, the duration of Spirit is a compound Duration ; not so momentary as that of Flame, nor yet so permanent as that of Air. It differs also so much the more from Flame, because Flame is extinguish'd by Accident or by Contraries, and the surrounding

* See more of this in the ensuing *History of Winds*.

rounding Bodies that destroy it ; but Spirit, has no such Cause nor Necessity of its Destruction. Lastly, Spirit is repaired, or recruited, from the vivid and florid Blood of the finest Arteries ; which creep along the Brain. But this Repair is made in its own peculiar manner ; that comes not now to be considered.

A X I O M XXXII.

The vital Spirit is immediately destroy'd, upon being deprived of Motion, Coolness, or Aliment.

THESE three Things we call the *Avenues of Death* ; and they are *The vital Spirit how destroy'd.* the proper and immediate Passions of the vital Spirit : for all the Organs of the principal Parts serve to perform these three Offices ; and all the mortal Destructions of the Organs terminate in one or more of them : whence the rest are but different Paths to Death ; that end at last in these three grand Roads or Avenues. But the whole Fabrick and Structure of the Parts, is the Organ of the vital Spirit : and this Spirit itself is the Organ of the rational Soul ; which is incorporeal and divine †.

V O L. III.

K k k

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† When the whole of this Enquiry shall be duly prosecuted, and completed, the Number of these *Axioms* may perhaps be considerably lessen'd ; or included under others more general, and a few sure Rules discovered, for advantageously lengthening the present Period of Life : which we wish were not so generally looked upon as a Subject beyond the Reach of Men.



A
D R A U G H T
For the PARTICULAR
H I S T O R Y
OF THE
W I N D:

WITH
A V I E W to bring it under the Power of
M A N;

And render it farther subservient to

H U M A N U S E S.

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P R E F A C E.

THE following History of Winds, has scarce been more improved by the Moderns, than the preceding History of Life and Death. It should seem as if few entred into the Nature and Design of these Pieces; so as to perceive how far they are carried; and how they may be farther advanced: and yet the Author appears to have given ample Directions for the Purpose. For tho he has himself gone great Lengths in these particular Histories; yet they are rather intended as larger Examples, to teach Mankind the Method of Enquiring; than aim at being complete Enquiries themselves^a.

Numerous Observations have been made, and Journals kept of the Wind and the Weather. but even complete Sets of such Observations will afford little Instruction; unless they are regularly tabled, and offered to the Mind in some tolerable order. Perhaps it would not be amiss, if all the Observations of this kind were ranged under the following Heads; or, if these be insufficient, under others of the same general kind; that their Doctrine might be drawn out, and a better Acquaintance cultivated with the Subject. This would be making that Use of the present History which the Author encourages, and plainly intended.

I N T R O.

^a No Author has with greater Diligence and Exactness, I will not say enquired into, as taught others the way of enquiring into this Subject, than the great Lord Verulam, in his *History of Winds*. And tho he there writes historically in many Particulars, I cannot determine whether they may safely be relied on. That Man had a vast and most extensive Genius; equal, in my Opinion, to the full Discovery of all Nature; had he not been prevented by Civil Affairs. Yet, notwithstanding his Post, and Employments, he has set on foot such a *Method of Enquiries* as opens the widest Field to the Labours of others. His single *History of Winds* sufficiently demonstrates his incredible Capacity and Diligence; by the Clue and Direction whereof, infinite Remarks and Observations may be made, appertaining to this Subject. *Morhof. in Polylog.* Tom. II. Cap. 23. *de Meteoris Aëreis, præcipue de Ventis*, pag. 381.

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INTRODUCTION.

THE *Winds* may be called the Wings of Mankind ; by means whereof Men fly thro' the Sea, and maintain Traffick and Correspondence with all the Parts of the Globe. They are also the Sweepers of Man's Habitation, the Earth ; and at the same time brush and cleanse the Air about it. On the other Hand, they sometimes tear up and enrage the Sea, that wou'd otherwise remain quiet or undestructive ; and have likewise other mischievous Effects. Again, they produce strong and violent Motions, without human Assistance ; and thus, as Servants to Mankind, drive our Ships, and turn our Mills. They might also be applied to abundance of other useful Purposes ; if Men wou'd exert their Diligence. The Nature of the Winds is usually reckon'd an occult and secret Thing ; and no wonder, whilst the Nature and Power of the Air, which the Winds administer to and wait upon ; (as in the Language of the Poets, *Æolus* does on *Juno*) remain absolutely unknown. They are not primary Creatures, or of the first six days Works, as to their Action ; no more than the other Meteors ; but were produced later in the Order of Creation.

STUDY

1

A
D R A U G H T
For the PARTICULAR
H I S T O R Y
O F T H E
W I N D, &c.

S E C T. I.

*The Table of Enquiry; or a Set of Heads for the
Particular HISTORY of the WIND: With the
Conduct to be observed in the Prosecution.*

T I T L E I.

The Names of the Winds.

D I R E C T I O N.

1. **U**NDER this *Title* class the Winds, with regard to the Points of the Compass, or the Method observed at Sea; and assign them their several Names, antient or modern; so as to denote them fixedly and invariably.

2. *Winds* are either (1.) general, (2.) stated, (3.) serving^b, or (4.) free. We call those *general Winds*, which never cease to blow; those *stated Winds*, which blow only at certain times; those *serving Winds*, which blow oftenest; and those *free Winds*, which blow indifferently at all times.

V o l. III.

L II

T I T L E

^b See this Term explain'd under Sect. V. See also below, *Title IV.*

The HISTORY of the WIND.

T I T L E II.

General Winds.

D I R E C T I O N.

3. Enquire whether there be any general Winds, and genuine Motions of the Air itself; and, if there be, in what Series of Motion, and in what Places they blow.

T I T L E III.

Stated Winds.

D I R E C T I O N.

4. Enquire what Winds are annual, and periodical, and in what Countries; and whether there be any Winds so precisely stated, as to return regularly at certain Days and Hours, like the Tide of the Sea.

T I T L E IV.

Serving Winds.

D I R E C T I O N.

5. Enquire what Winds are waiting and familiar, or most constant to what Countries; at what times they blow in those Countries; which in the Spring; which in the Summer; which in the Autumn; which in the Winter; which are Æquinoctial; which Solstitial; which blow in the Morning; which at Noon; which in the Evening; and which at Night.

6. Again, enquire which are Sea-winds; and which blow from the Continent: and exactly observe the Differences between the Sea and Land-winds; as well those that blow upon, as those that blow from the Land and Sea.

T I T L E V.

Free Winds.

D I R E C T I O N.

7. Enquire whether Winds do not blow from all Points of the Heavens.

8. Winds do not differ much more in the Quarters they blow from, than in their Qualities; some being strong, others gentle; some constant, others variable;

variable ; some cold, others hot ; some moist, and dissolving, others dry, and constringing ; some bringing Clouds, Rain, or Storms ; others calming, and clearing the Air.

T I T L E VI.

The different Qualities of Winds.

D I R E C T I O N.

9. Enquire into and give the History of the several Species, or abovemention'd Differences of Winds ; and how they vary, as to Climates and Countries.

10. There are three local Origins of Winds ; as being either, (1.) precipitated from above ; (2.) rising out of the Earth^c ; or (3.) produced in the Body of the Air itself.

T I T L E VII.

The Local Origins of Winds:

D I R E C T I O N.

11. Enquire after the three abovemention'd *Origins of Winds* ; viz. (1.) Which of them descend from that call'd the middle Region of the Air ; (2.) Which breathe from the Caverns of the Earth ; whether they rush out boisterous, and in a Body ; or escape insensibly, by degrees, and afterwards roll together, as Rivulets collect into Rivers ; (3.) And lastly, which of them are generated indifferently, in all places, from the swelling and expanding of the contiguous Air.

12. But all the Productions of Winds are not Original ; some being accidental, and proceeding from a Compression, Percussion, and Repercussion of the Air.

T I T L E VIII.

Accidental Generations, or Productions, of Winds.

D I R E C T I O N.

13. Let enquiry be made into all the *accidental Generations of Winds* : tho these are not proper Generations of Winds ; but rather increase and strengthen them, than actually produce and excite them.

L 11 2

14. And

^c And Sea.

The HISTORY of the WIND.

14. And so much for the Winds that commonly obtain. But besides these there are also certain *extraordinary Winds*, out of the common Course ; such as *fiery Winds*, *Whirlwinds*, *stormy Winds*, and *Tornados* ; and these rage above Ground : there are likewise *subterraneous Winds* ; some whereof are vaporous, sultry, and mercurial ; as in Mines : others sulphureous and burst out of Chafins, caus'd by Earthquakes ; or rise hot from burning Mountains.

T I T L E IX.

Extraordinary Winds, and sudden Gusts.

D I R E C T I O N.

15. Enquire into all uncommon, monstrous and miraculous kinds of Winds.

16. From the particular Kinds of Winds, let the Enquiry pass on to the Things which contribute to them ; or are supposed to raise or lay them.

T I T L E X.

The Things that contribute to Winds ; and excite or appease them.

D I R E C T I O N.

17. The Enquiry shou'd not run out into Astrological Considerations about the Winds ; nor Accuracies as to the Horoscope of the Heavens : only the more manifest Observations of the Winds increasing at the rising of certain Stars, or the Eclipsing of the Luminaries, or the Conjunctions of the Planets, are not to be neglected : and remark how far they depend upon the Course of the Sun or Moon.

18. Enquire what the different kinds of Meteors contribute to the Winds ; what Earthquakes contribute ; what Showers ; and what the meeting of Winds together : for these Things hang in a Chain, and draw in each other.

19. Enquire what a diversity of Vapours and Exhalations contributes to Winds ; and which Kinds of them are the more productive of Winds ; and how far the nature of Winds depends upon these their Materials.

20. Enquire what those Things contribute or make to Winds, which are found upon the Earth ; what the Mountains contribute, and the dissolving of Snow upon their Tops ; what those huge Masses of Ice which float, and are carried about in the Sea ; what the difference of Soil, or any large Tracts of Land, as Marshes, Sands, Woods, Champaigns, &c. Again, enquire what those Things contribute which are performed by human Agency ; as the burning of Heath, Fuzzes, &c. for the improvement of Land ; the burning of Corn, or Villages, as in Wars ; the Draining of marshy Lands ; the continual discharging of Cannon ; the ringing of numerous

rous Bells together, as in great Cities, &c. 'Tis true, these are smaller Matters ; but they may have some Effect.

21. Enquire into all the Ways of raising and laying the Winds ; tho sparingly as to any of the fabulous or superstitious Methods of doing it.

22. From hence let the Enquiry pass on to the Limitations of the Winds, in Height, Extension, and Duration.

T I T L E XI.

The Limitations of the Winds.

D I R E C T I O N.

23. Let diligent Enquiry be made as to the Height, or Elevation, of the Winds ; and if there be any Tops of Mountains where the Winds blow not ; or if the Clouds sometimes appear motionless and stationary, at the same time that the Winds are blowing strong upon the Earth.

24. Enquire carefully into the Space which the Winds are found at once to possess ; and within what Bounds they keep. For Example, suppose the South Wind should blow in a certain Place ; enquire whether the North Wind actually blow at the same time, ten Miles from that Place. And again, enquire into how narrow a Compass the Winds may be reduced, whilst they run, as it were, thro' Pipes ; which they seem to do in some kinds of Whirlwinds.

25. Enquire how long Winds usually continue in their greatest, mean, or smallest Duration, before they slacken, and as it were expire again ; in what manner they rise and begin ; and in what manner they languish and cease ; whether of a sudden, by degrees, or how.

26. From these Limits of the Winds, let the Enquiry proceed to their *Successions* ; either among themselves, or with regard to Rain and Showers : for as all Winds and Rain lead up each other, it would be a pleasure to know what Order they dance in.

T I T L E XII.

The Successions of the Winds.

D I R E C T I O N.

27. Enquire whether there be any Rule, or certain Observation, as to the Order in which the Winds succeed one another ; and whether it be conformable to the Sun's Motion, or otherwise ; and however it be, to discover the Fact.

28. Enquire concerning the Succession and Interchange of Winds and Rain : since it is usual for Rain to allay the Winds ; and for the Winds to keep up and dissipate Rain.

29. Observe

29. Observe whether the Succession of the Winds is renewed after a certain period of Years ; and, if so, to find what that Period is.

30. From the Order of Succession, let the Enquiry glide on to the Motions of the Winds. The Motions of the Winds branch themselves into seven distinct Enquiries ; three whereof are contained in the preceding Articles ; and four remain hitherto untouched : for we have already mention'd, (1.) That Motion of them, which regards the Points of the Compass they blow from. (2.) Their Motion in the three Lines of Direction, upwards, downwards, and sidewise. (3.) Their accidental Motion by Compression ; so that there remains, (4.) Their progressive Motion. (5.) Their undulatory Motion. (6.) Their impinging Motion. And, (7.) Their Motion in Organs, and Machines of human Invention.

T I T L E XIII.

Different Motions of the Winds.

D I R E C T I O N.

31. As Progression always begins from a certain Point ; let a very careful Enquiry be made into the Place of the primary Rise, or, as it were, first Fountain of the Winds : for Winds resemble Fame ; and tho they tumultuate and bluster every where, yet hide their Heads among the Clouds. Again, enquire into their Progress itself : for Example, if a strong North Wind blew, upon a certain Day and Hour, at *York* ; suppose it should, two Days afterwards be found to blow at *London*, &c.

32. The Enquiry into the Undulation of the Winds must not be omitted. We call that Motion the Undulation of the Winds, wherein a Wind, for a small Space, increases and slackens, or swells and falls again, like the Waves of the Sea ; the Reciprocation whereof is known from the Sound they make in Buildings. And the Differences of this Undulation, or Rising and Falling, betwixt the Air and Water, must be the more carefully observed ; because the Air and Winds have not that great Motion of Gravity, which is the chief Cause of the Undulation in Waters.

33. Let the Enquiry be carefully pursued, with regard to the impinging, or meeting of strong Winds together ; and blowing at the same time : as first, whether many original Winds may blow, and dash against one another at once ; and, if this happen, what Reciprocation it causes in the Motion : and again, what Condensations and Alterations it produces in the Body of the Air.

34. Enquire whether some Winds do not blow at the same time above, that others blow below : for Clouds have been sometimes observed to move in a contrary Direction to that of the Weather-cock ; and sometimes to be driven briskly, whilst there was a perfect Calm near the Surface of the Earth.

35. Let a very exact, careful, and particular Description be made of the Motion of the Winds in the sailing of Ships.

36. Describe the Motion of the Winds in the Sails of Wind-mills, the Flight of Hawks, and other Birds ; and even in the common Phænomena and Diversions ; as the hoisting of Flags and Streamers ; the flying of Paper-Kites ; fighting of Battles by the Wind, &c. And now, from the Motions, let the Enquiry pass on to the Force and Powers of the Winds.

T I T L E X I V .

The Powers of the Winds.

D I R E C T I O N .

37. Enquire what Effects the Winds may have upon the Tides and Currents ; as to keeping them out, driving them in, and causing them to overflow.

38. Enquire their Effect upon Vegetables and Insects ; as to their bringing in of Locusts, Canker-worms, Mill-dews, Blights, Blasts, &c. ^d

39. Enquire their Effects, as to purging and infecting the Air ; the producing of Pestilences, Diseases, and Disorders in Animals.

40. Enquire into their manner of conveying those called *spiritual Species* ; as Sounds, Emissions, Light &c, &c.

41. From these Powers of the Winds, let the Enquiry descend to the Prognosticks of Winds ; not only for the Use of Predictions, but on account of their leading up to Causes : for Prognosticks either discover the Preparation of Things, before they come into Action ; or their Beginnings, before they become manifest to the Senses.

T I T L E X V .

Prefages or Prognosticks of Winds.

D I R E C T I O N .

42. Let great Diligence be used to collect all the kinds of Prognostications of Winds, except those of an astrological Nature ; with regard to which we have above laid down our Directions^e : otherwise they may be derived from Meteors, Waters, the Instinct of Animals, and many other things.

43. Lastly. Let the whole Enquiry be closed by searching into Methods of imitating the Winds, for natural as well as artificial Purposes.

T I T L E

^d Viz. The scattering abroad, and sowing the Seeds of Vegetables ; in different Places, &c.

^e See Dr. Derham's Paper upon the Motion of Sounds, in the *Philosophical Transactions*.

^f § 17.

TITLE XVI.

Imitations of Winds.

DIRECTION.

44. Enquire into the Imitations of Winds in natural Subjects; such are the Flatulencies in animal Bodies; and the Puffings, or Displosions of Subjects in chemical Distillations.

45. To conclude; Let Enquiry be made into *fartitious* and *artificial Winds*, Gales, and Fannings; as by Bellows, Refrigeratories, or Cool-Rooms, &c.

46. Such are the *Heads* requisite to a *particular History of the Winds*; but we expect not that our present Stock of Experience should be able to answer them all. However, as in Trials at Law, a good Lawyer knows how to put such Questions as the Case requires; but knows not what the Witnesses will answer: so we can proceed no otherwise in the *grand Cause betwixt Nature and Mankind*; and must leave Posterity to see the Issue.

S E C T. II.

The History of the Appellations of the WINDS; assigning to each a proper, fixed, and determinate Name; in prosecution of the first Article of the Table of Enquiry.

The ancient Names of the Winds preserved.

1. **F**OR the sake of Clearness, and to help the Memory, we would enumerate and range the Winds, rather according to their natural Order and Degrees, than under the Names and Method assigned them by Antiquity. We shall, however, annex their ancient Names, that the ancient Authors from whom we have borrowed many Particulars (tho without trusting to them) may be the readier consulted.

The general Division of the Winds.

2. And for the *general Division of the Winds*; let those be termed, (1.) *Cardinal Winds*, which blow from the four Quarters, or Cardinal Points of the World; those, (2.) *Semi-cardinal*, which blow in the middle between the former; and those, (3.) *Median*, which blow any where betwixt the others: but of these *Median Winds*, let those be called, (4.) the *Greater Medians*, that blow in the Quarters; and all the rest be termed, (5.) the *Lesser Median Winds*.

3. The

§ These Articles are not fully spoke to in the following Enquiry; and indeed the Whole, however great in itself, should be esteemed as little more than the Out-lines of a *Natural History of the Wind*; that wants to be filled up by future Labour, Experiments, and Observations.

h See *Varenii Geographia*, Cap. 20. and 21.

3. The particular Division of the Winds is expressed by the following Table. Their particular Division.

A TABLE shewing the particular Divisions of the WINDS ; with regard to the Mariner's Compass.

I.

- | | | |
|-------------------------------|---|--|
| 1. NORTH. ——— | | A Cardinal Point. |
| 2. North and by East. ——— | | The North Wind one Point to the East. |
| 3. North-North-East. ——— | } | The North Wind two Points to the East.
A greater Median Wind ; anciently called <i>Aquilo</i> . |
| 4. North-East and by North. — | } | The North Wind three Points to the East ;
anciently called <i>Mefes</i> . |
| 5. North-East. ——— | } | A Semi-cardinal Wind ; or North four
Points to the East. |
| 6. North-East and by East. — | | Or, North five Points to the East. |
| 7. East-North-East. ——— | } | Or, North six Points to the East. A
greater Median Wind ; anciently
called <i>Cæcias</i> . |
| 8. East and by North. ——— | | Or, North seven Points to the East. |

II.

- | | | |
|-------------------------------|---|---|
| 1. EAST. ——— | | A Cardinal Wind ; anciently called <i>Subsolanus</i> . |
| 2. East and by South. ——— | | Or, East one Point to the South. |
| 3. East-South-East. ——— | } | Or, East two Points to the South. A
greater Median Wind ; anciently called
<i>Vulturnus</i> . |
| 4. South-East and by East. — | } | Or, East three Points to the South. |
| 5. South-East. ——— | } | A Semi-cardinal Wind. Or, East four
Points to the South. |
| 6. South-East and by South. — | | Or, East five Points to the South. |
| 7. South-South-East. ——— | } | Or, East six Points to the South. A
greater Median Wind ; anciently
called <i>Phœnicias</i> . |
| 8. South and by East. ——— | | Or, East seven Points to the South. |

III.

- | | | |
|---------------------------|--|--|
| 1. SOUTH. ——— | | A Cardinal Wind ; anciently called <i>Notus</i> or <i>Auster</i> . |
| 2. South and by West. ——— | | Or, South one Point to the West. |

The HISTORY of the WIND.

- | | | |
|---------------------------------|---|--|
| 3. South-South-West. ——— | { | Or, South two Points to the West. A greater Median Wind; anciently called <i>Libonotus</i> . |
| 4. South-West and by South. ——— | { | Or, South three Points to the West. |
| 5. South-West. ——— | { | Or, South four Points to the West. A Semi-cardinal Wind; anciently called <i>Libs</i> . |
| 6. South-West and by West. ——— | { | Or, South five Points to the West. |
| 7. West-South-West. ——— | { | Or, South six Points to the West. A greater Median Wind; anciently called <i>Africus</i> . |
| 8. West and by South. ——— | { | Or, South seven Points to the West. |

IV.

- | | | |
|---------------------------------|---|--|
| 1. WEST. ——— | { | A Cardinal Wind, anciently called <i>Favonius</i> . |
| 2. West and by North. ——— | { | Or, West one Point to the North. |
| 3. West-North-West. ——— | { | A greater Median Wind. Or, West two Points to the North; and anciently called <i>Corus</i> . |
| 4. North-West and by West. ——— | { | Or, West three Points to the North. |
| 5. North-West. ——— | { | A Semi-cardinal Wind. Or, West four Points to the North. |
| 6. North-West and by North. ——— | { | Or, West five Points to the North; and anciently called <i>Tbrafcias</i> . |
| 7. North-North-West. ——— | { | Or, West six Points to the North. A greater Median Wind; anciently called <i>Circius</i> . |
| 8. North and by West. ——— | { | Or, West seven Points to the North. |

4. There are, besides these, other ancient Names of Winds; as *Apeliotes*, *Argestes*, *Olympias*, *Sciron*, *Hellepontius*, *Iapyx*, &c. but we pay little regard to them; 'tis sufficient to have given fix'd Appellations to the several Winds in the regular Order and Division of the *Horizon*: for we lay no Stress upon the understanding of Authors; as Authors contain but very little to our Purpose.

S E C T.

S E C T. III.

Of Free and General WINDS; with regard to the second and fifth Articles of the Table of Enquiry.

1. THERE is no Point of the Heavens, but a Wind may blow from it; so that if the Heavens were divided into as many Points as there are Degrees in the Horizon, there will, one time or other, be found Winds blowing from each¹.

Winds may blow from all the Points of the Heavens.

2. There are some whole Countries where it never rains, or at most very seldom; but none where the Winds do not blow; and that frequently.

Some Countries without Rain.

3. There are few Phænomena observed of *General Winds*; and no wonder, as these Winds are principally found within the Tropicks, where chiefly lie the Places condemned by the Ancients for uninhabitable. But those who sail in the open Sea, between the Tropicks, observe a Wind, or Breeze, continually blowing from East to West; which is not so gentle, but that partly by its own Motion, and partly by affecting the Current of the Sea, it renders it impossible for Ships to return towards *Peru*, the same way they came.

General Winds chiefly within the Tropicks.

4. In our *European Seas*, there is observed (when the Heavens are clear and serene, and no particular Winds stirring) a certain gentle Breeze, breathing from the East, and following the Sun.

A Breeze following the Sun in the European Seas.

5. 'Tis found by common Observation, that the higher Clouds generally move from East to West; and this even at the same time when there is Calm, or a Wind blowing in a contrary Direction, near the Surface of the Earth. And if this prove not always the Case, the Reason may be owing to *particular Winds*, sometimes blowing above; so as to disturb, or over-power this *General Wind*.

The Motion of the higher Clouds.

A D M O N I T I O N.

If there be any such *general Wind*, proceeding from the Order of the Motion of the Heavens, it is not strong enough to resist the *particular Winds*. And such a Wind becomes more manifest within the Tropicks, by reason of the larger Circles it there has to move in; and also high up, for the same reason; and to enjoy the freer Course. Therefore, whoever would endeavour to discover this Wind without the Tropicks, and near the Earth's Surface (where it breathes but small and soft) let him make the Experiment in the open and free Air, in the greatest Calms, and highest Places; and that with a very moveable Body; and towards the Evening; because at this time the particular East Wind blows less.

Directions for discovering the general Winds out of the Tropicks.

M m m 2

P R E-

¹ That is, supposing, for Example, the Horizon divided into 360 Degrees; as all Circles are by Mathematicians.

P R E C E P T.

Weather-cocks to be observed. Let a careful Observation be made of the Weather-cock, Vanes, Streamers, and the like, on the Tops of Steeples, high Edifices, Ships, &c. in order to determine whether, in the greatest Calms, they do not always tend to the West.

Indirect Phænomena.

Whence the West Wind more beneficial than the East. 6. 'Tis matter of Observation, that the East Wind in *Europe* is a sharp and drying Wind; but the West Wind, on the contrary, moist and favourable. Does not this proceed from hence, that, upon a Supposition of the Air's Motion from East to West, the East Wind, which goes also in that Direction, necessarily rarifies, and drives the Air before it, so as to make it more dry and predatory; whereas the West Wind, which moves in a contrary Direction, condenses, and turns the Air back upon itself; from whence it becomes less sharp or cutting, and afterwards moistening?

Whether the Sea moves from East to West. 7. Consult the *Enquiry of the Motion of the Tides* *, to discover whether the Waters move from East to West: for if the Heavens, and the Waters, which are the Extremities of the Air, have this Motion; 'tis highly probable that the Air itself, which lies between them, participates of it likewise.

A D M O N I T I O N S.

Indirect Phænomena, what. (1.) The two preceding *Phænomena* we call indirect; as not pointing out the thing immediately, but consequentially: and this is a kind of *Phænomena* which we willingly admit and receive; in defect of a sufficient Stock of direct ones.

Conjectures at the Causes of the constant Breeze with- in the Tropicks. (2.) 'Tis certain Fact, that there blows a constant, manifest Breeze between the Tropicks; but the *Cause* thereof is doubtful. It may be owing to this; that the Air, as we before observed, moves in the direction of the Heavens; but less perceptibly without the Tropicks, because of the smaller Circles there. Another Reason may be this; that all Air is expanded by Heat; and, by this Expansion, the contiguous Air is of necessity impell'd, so as to create that constant Breeze; whilst the Sun holds on its Course: but this Expansion must be more considerable within the Tropicks, where the Sun is hottest; and again, but small without them, where 'tis colder. It might seem a *Crucial Instance*† for solving this Difficulty, were it but known, whether this Breeze continues by Night, or not; because the Rotation of the Air continues by Night, tho the Heat of the Sun does not.

This Breeze ceases by Night. (3.) Now 'tis certain this Breeze comes not in the Night; but in the Morning, or some time after the Sun is up. Yet this Instance does not determine

* See the *Novum Organum*, Part II.

† See *Novum Organum*, Part II. Aph. XXXVI.

termine the Point ; becauſe the nocturnal Condensation of the Air, eſpecially in ſuch Places where the Day and Night are as different in Heat and Coldneſs, as they are equal in their Lengths, may check and confound this natural but gentle Motion ^a.

(4.) If the Air participate of the Motion of the Heavens ; it follows, not only that the Eaſt Wind coincides with, whiſt the Weſt Wind opposes, the Motion of the Air ; but alſo, that the North Wind blows, as it were from above ; and the South Wind as from below, in our Hemisphere ; where the South Pole is depreſſed, and the North Pole elevated above the Horizon. And this Obſervation was made by the Ancients, tho with uncertainty and obſcurity : but it excellently agrees with modern Experience ; becauſe the conſtant Breeze we ſpeak of, which may be a Motion of the Air, is not due Eaſt, but North-eaſterly ^a.

The Conſequence, if the Air moves with the Heavens.

SECTION IV.

Of Stated WINDS with regard to the third Article of the Table of Enquiry.

TRANSITION.

AS the Minds of Men ſeem to have been dark in the Enquiry about general Winds ; ſo, in that of ſtated Winds they ſeem to have been giddy : for of the former they ſay nothing ; and of the latter they talk very ramblingly. But this is the more pardonable, becauſe the thing itſelf is variable ; ſince ſtated Winds change with the Place, ſo as not to blow the ſame, for inſtance, in Egypt, Greece, and Italy.

The Subject of ſtated Winds tread unſtediſtly.

1. That there are *ſtated Winds* in ſome Place or other, may appear from the very Name ; and again, from that other Appellation of *Eteſian*, or *Anniverſary Winds*.

Eteſian or anniverſary Winds.

2. One *Cauſe* of the overflowing of the Nile, was antiently made the blowing of the *Eteſian*, or northerly Winds, at that time of the Year ; ſo as to prevent the Courſe of the River into the Sea, and drive it backwards.

Overflowing of the Nile imputed to the Eteſian Winds.

3. There are *Currents* found in the Sea, which can neither be attributed to the natural Motion of the Ocean, nor to the Declivity of more elevated Parts, nor to the Straitneſs of oppoſite Shores, nor to Promontories running out into the Sea ; but are plainly governed by *ſtated Winds*.

Currents owing to ſtated Winds.

4. Thoſe who will not allow *Columbus* to have conceived ſo certain and fixed an Opinion of the *Weſt-Indies*, from the Relation of a *Spaniſh Pilot*, yet think it trifling for him to have formed it upon the obſcure Traces and Rumours of *Indies*.

The Discoveries of the Weſt-Indies ſuppoſed owing to theſe Rumours of Indies.

^a See the Appendix to Dr. Jurin's Edition of Varenus, Pag. 31—39.

^b Some Additions might be made to this Section, from Mr. Beſhun's Diſcourſe concerning the Origin and Properties of Winds. Printed at Oxford An. 1671. See Pag. 68—100, &c.

Rumours of Antiquity, pretend he conjectured there must be a *Continent to the West*, from the *stated Winds* on the Coast of *Portugal*. And tho this be an uncertain and somewhat improbable thing; since the Course of those Winds can scarce be kept for so great a Distance; yet it derives Honour to the present Enquiry, if the *Discovery of a new World* be owing to one *Axiom*, or *Observation*, of the many it contains.

Stated Winds from snowy Mountains. And marshy Grounds.

5. Wherever there are high Mountains covered with Snow; *stated Winds* blow from that Quarter at the time the Snow dissolves.

From periodical Vapours.

6. We suspect also, that *stated Winds* may blow from great Tracts of Marsh-land, overflow'd in the Winter; and this about such time as the Sun begins to dry up the Water: but of this we have no settled Observation.

Stated Winds from far.

7. Wherever Vapours are generated in great abundance, and this at certain Times; *stated Winds* are there found to rise, at those Times.

8. When *stated Winds* blow in any Place, and their Cause be not found near at hand; such *stated Winds* must be deemed foreign, and to come from far.

Do not blow in the Night.

9. 'Tis observed, that *stated Winds* blow not in the Night; but rise about three Hours after the Sun is up: whence they seem to be so weakened, or, as it were, tired with a long Journey, that they can scarce break thro' the nocturnal Condensation of the Air; but are again quickened and recover'd a little after Sun-rising.

Generally weak.

10. All *stated Winds* are weak, except they blow from Places near at hand; and ever yield to the Winds that rise of a sudden.

11. There are many *stated Winds* which we do not perceive, or observe, by reason of their Weakness; as being suppressed, or over-powered, by the free Winds: and are therefore scarce found in the Winter, when the free Winds are most abroad; but rather towards the Summer, when such wandering Winds are stiller.

The stated Winds of Europe.

12. In *Europe*, the principal *stated Winds* are, (1.) Northerly Winds, from the Solstice; and these both precede and follow the Rise of the Dog-star; (2.) the West Winds, from the autumnal Equinox; and, (3.) the East Winds, from the vernal: but for the Winter Solstice, 'tis not much to be regarded, because of the Changes and Alterations whereto the Winter is subject.

The Bird-Winds.

13. The *Bird-Winds*, (so called on account of their bringing Birds from cold Regions beyond the Sea, into warmer) have no relation to *stated Winds*; because they often deceive in point of Time: but let them blow sooner or later, the Birds wait for them; and frequently, after these Winds begin to blow, they again fall off, and fail the Birds, which thence drop into the Sea, and sometimes upon Ships.

The Returns of the Winds not known.

14. There is hitherto discovered no way of predicting the Return of the Winds, to a certain Day and Hour; as there is in the Case of the Tides: some Writers indeed, now and then fix a Day for their return; but they do this rather from conjecture than certain Observations*.

S E C T.

* Consult *Bohun's Discourse of Winds.*

SECT. V.

Of Serving WINDS; with regard to the fourth Article of the Table of Enquiry.

TRANSITION.

THIS Term of *Serving Winds* we have coined, to the end that Observations about them may not be lost; or confounded along with others. Our meaning is this. Divide, for Example, the Year into three, four, or five Parts, in whatever Country; and if any Wind blow there for two, three, or four of these Parts; and a contrary Wind but for one Part; then the Wind which blows ofteneft we call the *Serving* or *Waiting Wind* of that Country. And the like may be understood of the Weather.

1. The South and North Winds are the *Serving Winds* of the World; for these, and their Divisions, blow more frequently over all the Globe, than the East and West Winds, with their Divisions.
2. All the free Winds wait more upon the Winter than the Summer; but principally upon the Autumn and the Spring.
3. All the free Winds wait more upon the Regions without the Tropicks and polar Circles, than within them: for they generally blow little in the Torrid and Frigid Zones; but frequently in the Temperate.
4. So, likewise, all the free Winds, especially the strongest of them, blow oftener, and more violently; in the Morning and Evening, than at Noon and Night.
5. The free Winds are observed to blow more frequent in such Countries as lie hollow and cavernous, than in such as are more firm and solid ^p.

South and North Winds the Serving Winds of the Globe. The free Winds attend, chiefly, the Spring and Autumn. And without the Tropicks, Strongest at Morning and Evening. Most frequent in cavernous Countries.

ADMONITION.

Men have taken very little Pains to observe these *Serving Winds* in particular Countries; but if the Thing were done, it would be useful in many respects. Upon asking a certain intelligent Merchant, who was Master of a Colony in *Newfoundland*, and had wintered there himself, the Reason why that Country was reputed so extremely cold, beyond what the Climate promised? he replied, the Fact was not altogether so true as reported; but that the Causes were two: the one, that the huge Masses of Ice brought down by the Currents from the frozen Sea, passed along the Shores; the other, which he judged abundantly the more considerable, was, that the West Wind there, blows for a much greater part of the Year than the East; as it does also, *says he*, in *England*; but at the Fishery it blows cold from

The Coldness of Newfoundland, whence,

^p See hereafter, Sect. VII. 9, 10, &c.

from the Continent; whereas, in *England*, it blows warm from the Sea: but, *continues he*, if the East Wind blew so often, and so long in *England* as the West Wind does at the Fishery; the Cold in *England* would be much more intense, and equal, perhaps, to what it is there^a.

The West Wind attends the Afternoon. 6. The West Wind is the Attendant of the Afternoon; as generally blowing whilst the Sun descends from the Meridian: but this the East Wind does much seldomer.

The South, the Night. 7. The South Wind waits upon the Night; as often rising and blowing strongly at that time: but the North Wind tends more upon the Day.

The Serving Winds at Sea, differ from those of the Continent. 8. There are many and great Differences between the *Serving Winds* of the Sea, and those of the Continent; especially in the Particular which is said to have given *Columbus* the Hint for discovering the *West-Indies*; viz. that the Sea-Winds are not stated, as the Land-Winds generally are. For as the Sea abounds with Vapours, which are in a manner present indifferently; Winds are also there generated indifferently, and blow every way, with great inconstancy; as having no certain *Origins* or *Fountains*^{*}: whilst the Earth is very unequally provided of the Matter of Winds; some Parts of its Surface being well fitted for producing and increasing them; but others not; whence they here commonly blow from the Place of their Origin; and thence obtain their Direction.

The Waiting Winds at Peru. 9. *Acosta* seems to differ from himself, when he says, in one place, that the South Winds blow during almost the whole Year in *Peru*, and along the Coasts of the *South-Sea*; but, in another place, that the Sea-Winds principally blow along those Shores: for the South Wind there, is a Land Wind; so likewise are the North and the East; whilst only the West is a Sea-Wind in those Parts. He seems exactest in the first case; viz. that the South is a *Waiting Wind*, and there familiar; unless perhaps from the Name of the *South-Sea*, he either conceived wrong, or expressed himself improperly, and by South meant the West Wind; because this blows from the *South-Sea*. But the Sea called the *South-Sea*, is not properly a South Sea; but, as it were, a second *Western Ocean*, stretching in a like Direction with the *Atlantick*.

Sea Winds purer than Land Winds. 10. Sea-Winds are doubtless moister than Land-Winds, yet purer; and such as easier and more equably mix with a pure Air: for Land-Winds are ill compounded and smoaky. Nor let it be objected, that Sea-Winds are grosser, because of the Saltiness of the Sea; for the terrestrial Nature of the Salt does not suffer it to rise in Vapour.

How rendered warm or cold. 11. Sea-Winds are warm or cold, according as they participate of the two Qualities just now mentioned; viz. Humidity and Purity. By their Humidity they mitigate the Force of Cold; (for Dryness increases both Cold and Heat:) and again, they cool by their Purity; whence, without the Tropicks they are warm, but within them cold.

^a See Mr. Boyle's *History of Cold*, passim.

^{*} See hereafter, *Sett. VII.*

12. We judge that the Sea Winds are every where the *Serving Winds* of *Sea Winds the particular Countries*; especially on the Coasts: as Winds of finest blow from the Sea, by reason of the much greater stock of Matter thence supplied to them than by the Land; unless any *Stated Wind* should thro' some particular Cause, chance to blow from the Land. And let not *Stated Winds* be confounded with *Waiting Winds*; for *Waiting Winds* ever blow ofteneft; but *Stated Winds* generally seldom; tho this they both have in common with other Winds, that they blow from the Place where they are generated.

13. Sea Winds are generally stronger than Land Winds; yet, when they cease, the Calm is greater out at Sea than near the Shore: insomuch that *Sea Winds stronger than Land Winds.* Sailors sometimes chuse to keep within the Winds of the Coast, rather than venture out; to avoid being becalmed.

14. *Recurrent Winds* blow from the Sea to the Shore; that is, such Winds as after having gone forwards for a while, turn back suddenly. And this seems owing to a certain Refraction, and Inequality, between the Breezes of the Sea, and those of the Land; for all Inequality of the Air is the beginning of a Wind. But these *Recurrent and Variable Winds* chiefly happen in Bays of the Sea. *Recurrent Winds, what and whence.*

15. There are Breezes generally found about all great Waters; especially in the Morning: but more about Rivers than at Sea, by reason of the difference betwixt the Breezes of the Land, and those of the Water. *Breezes found about Waters.*

16. Trees growing near the Sea-shore, are generally observed to bend away from the Sea Breezes; as if they had some Antipathy thereto: but this seems owing to the Humidity and Density of such Breezes; which renders them more ponderous and powerful. *Why Trees bend from the Sea Breezes.*

S E C T. VI.

Of the Qualities and Powers of the WINDS; in prosecution of the sixth and fourteenth Articles of the Table of Enquiry.

TRANSITION.

MEN have shewn little Diligence, and Curiosity, in observing the Qualities, and Powers, of the Winds. We shall here only select such Particulars relating thereto, as are more stable and certain; leaving the lighter to the Mercy of the Winds.

1. The South-Wind, with us, brings Rain; and the North, fair Weather. The former gathering and fostering the Clouds; the latter dissipating and dispersing them. Whence the Poets, when they describe the Deluge, feign the North Wind at that time imprison'd; and the South-Wind sent out with a very extensive Commission. *The South Wind rainy.*

The West Wind
favourable.

2. The West Wind is esteemed the Wind of the *Golden Age*; the Companion of perpetual Spring; and the Cherisher of Flowers.

The Paracel-
sists reject the
East Wind.

3. The School of *Paracelsus*, seeking a Place for their *three Principles* in the Temple of *Juno*, that is, the Air, have nicht the South, the North, and the West; but excluded the East.

The East Wind
accounted per-
nicious.

4. In *England*, we take the East for a pernicious Wind: whence our common Saying, *East is neither good for Man nor Beast*.

The more essen-
tial Differences
of the Winds.

5. The South Wind blows after the Sun has been present; but the North Wind, after the Sun has been absent in our Hemisphere: the East Wind, in the same Direction with the Air's Motion; but the West Wind always contrary thereto: the West Wind, from the Sea; the East, generally, from the Continent, in *Europe* and the western Parts of *Asia*. And these are the more essential Differences of the Winds; upon which most of their Powers and Qualities depend.

The South
Wind less sta-
ted than the
North.

6. The South Wind is less anniversary, and stated, than the North; as also more variable and free: and when become stated, 'tis so gentle as to be scarce perceptible.

The South
Wind blows
lower than the
North.

7. The South Wind blows lower, and more laterally; but the North Wind higher, and proceeds from above. This we mean not of the Elevation and Depression of the Pole above-mentioned; but that the South Wind has its Origin generally nearer the Earth, and the North Wind farther up from it.

The South a
fair Wind, in
Africa.

8. Tho the South Wind brings Rain with us, yet it brings fair Weather in *Africa*, and causes great Heats; *Africa*, however, is tolerably wholesome: but if the South Wind, with us, continue blowing fair Weather, without Rain, for a considerable time, it proves very pestilential.

The South and
West Winds,
whence rainy.

9. The South and West Winds generate no Vapours; but only blow from those Quarters where the greatest Quantity of Vapours is collected by the Increase of the Sun's Heat, which raises Vapours; and therefore these are rainy Winds: but if they proceed from dry Places, that are free from Vapours, they blow fair Weather; tho along with their Purity they are sometimes sultry.

The Agreement
betwixt the
South and
West; and
North and
East Winds.

10. The South and West Winds, with us in *England*, seem Confederates; being both of them warm and moist: on the other hand, the North and East Winds seem related; as both of them are cold and dry.

11. The North and South Winds blow oftener, as we touch'd above, than the East and West; because of the great Inequality of Vapours in the North and South Parts, occasioned there by the absence and presence of the Sun, which is, as it were, neutral or indifferent to the East and West.

The South and
North Wind
from the Sea.

12. The South Wind from the Sea is very wholesome; but more unhealthy from the Continent: on the contrary, the North Wind from the Sea is to be suspected; but from the Land it is wholesome. Again, the South Wind

¹ *Tincturis liquidum qui Mercurialibus Austrum,
Divitis & Zephyri rorante, Sulphure venas,
Et Boream tristi rigidum Sale.* —

Wind blowing from the Sea is very beneficial to Fruits and Plants ; driving away Mildews, Blaits and the like, from them.

13. A gentle South Wind does not greatly collect Clouds ; but often proves serene ; especially if it be of short continuance : but if it blow rough, or long, it causes a cloudy Sky, and brings on Rain ; tho it does this rather when it ceases or begins to fall, than when it first rises, or continues in its strength. *A South Wind serene.*

14. The South Wind, both in rising and falling, generally causes a change of Weather ; as from serene to cloudy ; or from hot to cold : on the contrary, the North Wind often rises and falls again, without altering the former state of the Weather. *Causes change of Weather.*

15. After Frosts, or long continued Snows, scarce any other Wind blows besides the South ; or if a Concoction were now made of the frozen Matters, which thus resolve : yet Rain does not always follow hereupon ; for there are some serene Thaws. *Blows after Frost.*

16. The South Wind rises oftener, and blows stronger, by night than by day ; especially in winter Nights : but the North Wind, if contrary to its custom, it should rise by night, seldom continues above three Days. *The South Wind strongest by Night.*

17. Greater Waves roll to the Shore when the South Wind, than when the North Wind blows ; tho they were both to blow with equal Force, or even the South Wind weakest. *North Winds make largest Waves.*

18. When the South Wind blows, the Sea appears blue, or more bright ; but when the North Wind blows, it appears blacker and darker. *Effects of the South and North Wind,*

19. When the Air grows warm of a sudden, it sometimes denotes Rain ; and, on the contrary, a cold Gale sometimes does the same : but this follows according to the Nature of the Wind ; for if the Air grow warm with a South or East Wind, it foretels Rain at hand ; and so likewise, when it grows cold with a North or West Wind. *on the appearance of the Sea. Rain how foretold.*

20. The South Wind generally blows by itself, and unattended ; but the North Wind, especially that which is six Points to the East, and the West two Points to the North, are often attended with other different and contrary Winds ; whence they are resisted, and rendered tumultuary. *The tumultuary Winds.*

21. The North Wind is to be avoided in the Sowing of Seed ; and the South Wind in the Business of inoculating and engrafting. *North Winds pernicious in Husbandry.*

22. The Leaves of Trees soonest fall off on the South side ; but Vines throw out their Shoots to the South, and scarce have any other Tendency. *Trees soonest shed on the South.*

23. *Pliny* observes, that in wide Pasture-grounds, Shepherds should drive their Flocks to the North side ; that they may feed up to the South ; because feeding against the North gives them Lameness, blear-Eyes, and the Scouring. He adds, that the North Wind debilitates them for Generation ; so that if they were to copulate with this Wind blowing in their Faces, they would generally produce Ewe-lambs : but in this, *Pliny*, acting only as a Transcriber, is not very consistent. *Sheep to respect the South Wind.*

24. There are three principal Times when Winds prove hurtful to growing Corn ; viz. (1.) in the opening of the Bud ; (2.) the going off the Bloom ; *When Winds damage the Corn.*

N n n 2

† How is this certainly known ?

Bloom ; and, (3.) near the time of ripening. In the latter case they empty the Ear, or blow out the Grain ; and in the former two, either strike off the Flower, or blast it in the Stem.

The Differences of the South and North Wind as to Health.

25. With the South Wind the Breath of Men smells stronger^u, Animals lose of their Appetite, pestilential Distempers are more frequent, Colds common, and the Bodies of Men more indisposed and heavy : but with the North Wind Men are more brisk, healthy, and better in Appetite. The North Wind, however, proves prejudicial to such as are troubled with the Pithisick, Coughs, the Gout, or any sharp Humour.

The Difference betwixt the East and West Wind. East Winds destructive in the Spring.

26. The East Wind is drying, predatory, and destructive ; but the West Wind moist, moderate, and cherishing.

27. The East Wind, blowing when the Spring is advanced, proves destructive to Fruits ; by bringing in Caterpillars and other Worms ; so as scarce to spare the Leaves ; nor is it friendly to Corn : the West Wind, on the contrary, is very favourable and friendly to Herbs, Flowers, and all the vegetable Tribe. The East Wind likewise, is somewhat favourable about the autumnal Equinox.

The West Winds more boisterous than the East. Rain with an East Wind. The more constant and changeable Winds. Vision and Hearing increased by Winds. The East-North-East Wind cloudy.

28. The West Winds are more boisterous, and ruffle and bend the Trees more than those from the East.

29. A rainy Season beginning with an East Wind, continues longer than that which begins with a West Wind ; and generally lasts a whole Day.

30. The East and North Winds, after once they begin to blow, are more constant and fixed ; but the South and West Winds, more variable.

31. With a strong East Wind all visible Objects appear larger ; but with a strong West Wind Sounds are more audible, and reach to a greater distance.

32. The East-North-East Wind, viz. six Points to the North, collects Clouds ; insomuch that this Wind became proverbial, among the *Greeks*, for a Cloud-gatherer ; whence they compared Usurers to it, who, by letting out Money fetch back more^v. 'Tis a violent but wide-spreading Wind ; so that it cannot drive away the Clouds quick enough to prevent their resisting, and forcing back upon it ; which is the case also in large Conflagrations, that make head and prevail against the Winds.

The Cardinal Winds not stormy. The calm and tempestuous Winds.

33. The Cardinal Winds, as also the Semi-cardinal, are not so strong as the Median.

34. The Median Winds from North to North-East, are more serene ; but from North-East to East more stormy. So likewise from East to South-East, they are more serene ; but from South-East to South, more stormy. So again, from South to South-West, more serene ; and from South-West to West, more stormy. And so, lastly, from West to North-West, more serene ; but from North-West to West, more stormy. So that, proceeding according to the Order of the Heavens, the Median Winds of the former Semi-

^u A strong North, or North-easterly Wind, has been found to have nearly the same Effects on some tender Bodies, as Mercury ; so as to occasion a fetid Breath, loosen the Teeth, cause a Spitting, &c. And this has been more particularly observed some Days or Weeks after the taking of mercurial Physick.

^v *Cassiam Nubes ad se trahere.*

Semi-cardinal, are always more disposed to be calm; and those of the latter to be tempestuous *.

35. Thunder, Lightning, and Storms happen when cold Winds blow; *The stormy and such as participate of the North: viz. the West-North-West, North Winds.* and by West, North-North-West, North-East and by North, and the East-North-East. And hence Thunder is often accompanied with Hail.

36. Snowy Winds also come from the North; but these are such Median *Snowy Winds.* Winds as are not stormy: for Example, the North-North-West; and the North-East and by East.

37. Winds obtain their Nature and Properties five several ways; *Whence the Properties of Winds.* viz. (1.) from the absence or presence of the Sun; (2.) an Agreement or Disagreement with the natural Motion of the Air; (3.) the Difference of the Matters whereof they are formed; as whether that of the Sea, Snow, Lakes, &c. (4.) the Impregnation of the Countries thro' which they pass; and, (5.) their local Origins; whether on high; under the Earth; or in the middle Region; all which will be better explained in the following *Sections.*

38. All the Winds have a greater Power of drying, even than the Sun *Drying Winds.* itself; because the Sun raises Vapours, but does not dissipate them, unless it beats very hot: whereas the Wind both raises them, and carries them off. But of all the Winds, the South has least of this Effect; for Stones and Woodwork are observed to sweat more with a gentle South Wind, than in a Calm.

39. *March Winds* are much more drying than Summer Winds; inasmuch that the Makers of musical Instruments wait the return of *March Winds.* for drying the Matter of their Instruments; and rendering it porous and sonorous.

40. All kinds of Winds purge the Air, and preserve it from Corruption; inasmuch that the most windy Years are the most wholesome. *Windy Years wholesome.*

41. The Sun has the Fate of Princes, whose Governours of remote Provinces, frequently have more submissive and obsequious Subjects than the Prince himself. Certainly the Winds, which have their Power and Origin from the Sun, govern and influence the Temperatures of Countries, and the Disposition of the Air, as much or more than the Sun itself. Whence *The Power of the Winds is the Temperature of particular Countries.* Peru is nearly as temperate, and its Air as mild, as in Europe; because, by lying near the Sea, and having very large Rivers, and exceeding great and high Mountains covered with Snow, it receives a great Supply of Winds and Breezes.

42. 'Tis no wonder that the Winds should have that Force we observe of them, since violent Winds are like Inundations, Torrents, and huge Waves of the Air; and yet, if carefully attended to, their Power does not seem very extraordinary. Their violent Effects are, such as the blowing down of Trees, which, being over-loaded with their own Tops, afford a kind of Sails for their own subversion. So likewise they may overturn Houses, that are slightly built; but for solid Buildings, they overturn them not; unless attended *The Strength of the Winds.*

* See the Table of the Divisions of the Winds, Sect. II. whence this will appear more distinctly than it can well be expressed:

The HISTORY of the WIND.

tended with Earthquakes. Sometimes also, they sweep down whole Magazines of Snow from the Mountains, and almost bury the Vallies with it; an Accident that befel *Solyman* in the *Sultanian Plains*. Sometimes likewise they cause great Inundations of Water.

43. The Winds sometimes blow whole Rivers out of their Channels, and leave their Bottoms bare; for if a strong Wind should, after a great Drought, continue blowing several Days, in the Direction of the Current, so as by tearing down the Water, to drive it into the Sea, and keep the Sea-Water from coming in, the River must necessarily become dry in many Places.

A D M O N I T I O N S.

*Observations
change with
the Poles.*

(1.) When the *Poles* are changed, the Observations also, as to North and South, must change: for as the absence and presence of the Sun is here the Cause; this varies according as the North or South Pole is elevated. But it may be an invariable thing, that there is more Sea towards the South, and more Land towards the North; which also contributes much to the difference of the Winds.

*The Uncertainty of the
Subject.*

(2.) Winds are generated a thousand ways, as we shall see presently; whence 'tis not easy to fix Observations in a Thing of so much uncertainty: but such as we lay down, will doubtless generally hold good.

S E C T. VII.

*The HISTORY of the Local Origins of WINDS; in
prosecution of the seventh Article of the Table of
Enquiry.*

T R A N S I T I O N.

*Difficult to fix
the Origin of
Winds.*

TIS a difficult Enquiry, to settle the *Local Origin of the Winds*; since whence they come, and whither they go, is, even in Scripture, remarked for a secret thing. And this we speak not as to the Fountains of particular Winds (of which hereafter;) but of the Wombs of the Winds in general. Some derive them from on high; some search for them in the Deep; but there are few who seek them in the Middle; where they are most frequently generated. And this is the manner of Men, to pass over what lies before their Feet, and look out for Obscurities. Thus much is certain, that Winds are either Natives, or Strangers, and as it were Traders in Vapours; importing them collected into Clouds, and exporting them again to and from different Countries; whence Winds are produced as by Traffick and Exchange. But our present Enquiry is about native Winds; for those which are foreign in some Parts, are Natives in others. There are then three local Origins hereof; viz. (1.) as they breathe out, or spring from

from the Earth ; (2.) as they are thrown down from on high ; and, (3.) as they are made up here in the Body of the Air. Those thrown down from above, are generated two ways ; being either precipitated before they are formed into Clouds ; or afterwards, when the Clouds are rarified and dispersed. We now proceed to their History.

1. The Poets fable, that the Kingdom of *Æolus* was seated in Dens and Caverns under the Earth ; where the Winds were imprisoned, and sometimes let out. *The poetical Notion of the Origin of Winds:*
2. Certain philosophical Divines dwell upon these Words of Scripture : *Who brings forth the Winds out of his Treasures.* As if the Winds proceeded from certain subterranean Repositories, or Magazines. But nothing can be built upon this ; for the Scripture likewise speaks of the *Treasures of Snow and Hail* ; which, no one doubts, are generated above. *The Notion of some scriptural Philosophers.*
3. There is, doubtless, a large Quantity of Air contained in the Bowels of the Earth ; and this probably may gradually breathe from thence ; and sometimes upon particular Causes rush out in a Body. *Air in the Bowels of the Earth.*

An Indirect Phenomenon.

In great Droughts and the midst of Summer, when the Earth cracks, large Quantities of Water are frequently observed to burst out in dry and sandy Places : and if Water, which is a gross Body, sometimes does this ; 'tis probable, that the subtile and rarified Body of Air may do it oftener. *That Air may burst out of the Earth.*

4. When Air breathes out of the Earth gradually, and in small Parcels, 'tis little perceived, at first ; but when many of these small Eruptions come together, they make a Wind ; as a River is formed of Springs. And this seems to be the Case ; because the Antients have observed, that many Winds, at their first Rise, and in the Places whence they rise, first blow weak ; but afterwards grow stronger, in their Progress ; exactly after the manner of Rivers. *Winds generated like Rivers.*

5. There are some Places found in the Sea, and also some Lakes, which swell very considerably, tho no Winds are there found to blow ; whence this should seem owing to some subterraneous Blasts. *Subterraneous Winds.*

6. A great Quantity or Force of subterraneous Spirit or Vapour, is necessary to shake or cleave the Earth ; but a less will serve to raise the Water : and therefore Earthquakes seldom happen ; but Swellings and Risings of the Waters frequently. *Swellings of the Sea more frequent than Earthquakes.*

7. 'Tis likewise a common Observation, that Waters swell and rise a little before Storms.

8. The weak subterraneous Spirit, or Vapour, that escapes in small Parcels, is not perceived upon the Earth till it gathers into a Wind ; because of the Porosity of the Earth : but when it gets out from under the Waters, 'tis presently

presently perceived, from the Swelling of the Waters, by reason of their Continuity.

Hollow rocky
Countries
windy.

9. We before observed *, that hollow and cavernous Countries have their *Waiting or Serving Winds*; insomuch that those Winds may truly seem to have their local Origins from the Earth.

10. On large rocky Mountains, the Winds are found to blow both sooner, that is, before they are perceived in the Vallies; and more frequent, that is, whilst the Vallies enjoy a Calm: but all Mountains and Rocks are cavernous.

11. In *Denbighshire*, in *Wales*, which is a mountainous and rocky Country, there are said to be such strong Eruptions of Winds from certain Caverns, as to toss back any kind of Apparel thrown into them, a great height into the Air.

12. There are certain Holes, in a rocky Cliff at *Aber Barry*, near the *Severn* in *Wales*, whereto if the Ear be applied, various Sounds and Murmurs are heard under the Earth.

An indirect Phænomenon.

Vents of Heat
and Cold in
the Earth.

Acosta observes, that the Towns of *Plata* and *Potosi* in *Peru*, lie not far asunder, and both of them situate in a rising or mountainous Ground; so as not to differ in this respect; and yet, that *Potosi* has a cold and wintery Temperature of Air; but *Plata* a mild and vernal one: which appears imputable to the Silver Mines near *Potosi*. And this seems to shew, that there are Vents of Heat and Cold in the Earth.

Warm Exha-
lations from
the Earth.

13. If the Earth be the *Primum Frigidum*, as *Parmenides* would have it, on a Supposition that Cold is close linked in with Density; 'tis no less probable that warm Exhalations should arise from the central Cold of the Earth; than that the like should be thrown down by the Cold of the upper Region.

Winds in Pits.

14. There are certain Pits in *Dalmatia*, and the Country of *Cyrene*, into which, as some of the Ancients relate, if a Stone be thrown, a Storm will soon after be raised; as if the Stone had broke some Covering in the Place where Winds were imprisoned.

An indirect Phænomenon.

Air may burst
from under
Ground.

Ætna, and many other Mountains, cast up Flames: in like manner, 'tis probable, that Air may break out; especially when expanded, and put into Motion, by subterranean Heat.

Winds before
and after
Earthquakes.

15. Certain noxious and foreign Winds are observed to blow, both before and after Earthquakes; in the same manner as a certain light and rarified Smoke rises before and after great Conflagrations.

ADMO.

ADMONITIONS.

(1.) Air, pent up in the Earth is compelled to break out, for several Reasons ; as, (1.) because sometimes the Earth hangs loose together, and falls into a Hollow ; (2.) sometimes the Waters make a Breach, or ingulf themselves under the Earth ; (3.) sometimes the Air is expanded by subterranean Fires, so as to endeavour at more room ; and, (4.) sometimes the Earth, which before was solid, is burnt hollow, and reduced to Ashes by Fire ; and thus being unable to support itself, falls in ; with many other Causes of the like kind. And so much for the first *local Origin of Winds* ; viz. from *subterranean Causes*. We come next to their *second Origin*, or that from above ; viz. the middle Region of the Air, as 'tis called.

Air variously discharged out of the Earth.

(2.) Let it not be supposed we any way deny that the other Winds may likewise proceed from Vapours of the Earth and Sea ; but what we have spoke to, is the first kind, which come out of the Earth, as Winds already formed.

That all Winds may proceed from Vapours.

16. Woods are observed to murmur, before any Winds are manifestly perceived ; whence 'tis conjectured that the Wind descends from on high. This is also observed in Mountains ; tho the Cause be here more doubtful, by reason of their Caverns.

Winds from above.

17. Winds follow upon the Shooting of the Stars, as 'tis vulgarly called, and come from that Quarter where the Star shot : whence it appears, that the Air is in commotion above, before we feel the Effects of it below.

Follow the Shooting of Stars.

18. The opening of the Firmament, and the scattering of the Clouds, foreshew Winds, before they blow upon the Earth : which, again, is a Proof that Winds begin above.

Opening of the Clouds.

19. The smaller Stars are not perceived before the Wind rises, tho the Night be clear : whence the Air seems to be condensed, and rendered less transparent, by the Matter which is afterwards resolved into Wind.

Clear Stars.

20. Halo's about the Body of the Moon ; the Sun setting blood-red ; the Moon rising red, on the fourth Day after the Change ; with many other Prognosticks of Winds, derived from above, shew the Matter of them to be there begun, and prepared.

Halo's, &c.

21. From these Phænomena we may observe the Difference already mentioned, as to the two ways wherein Winds are generated above ; viz. before and after the Collection of Vapours into Clouds : for the Prognosticks from Halo's, and the Colour of the Sun and Moon depend, in some measure, upon Cloudiness ; but the Shooting and Appearance of the lesser Stars, are observed in a clear Sky.

The Winds, how generated above.

22. When Wind issues from a formed Cloud, either the Cloud is totally dissipated, and converted into Wind ; or separated, part into Rain, and part into Wind ; or rent asunder, when the Wind bursts out as in a Storm.

The issuing of Winds from Clouds.

23. There are every where many *indirect Phænomena* in Nature with regard to the Reflection by Cold ; and therefore as the Cold is very intense in

the middle Region of the Air, Vapours cannot, generally, break thro' that Region ; but must either be coagulated, or darted out again ; according to the Opinion of the Ancients, which, in this Particular, is just.

A third Origin of Winds near the Earth. 24. There is a third *local Origin of Winds*, here in the lower Air ; which we call by the Name of SWELLS or OVERCHARGES of the Air : the Thing itself is familiar and obvious ; but hitherto passed over in silence.

EXPLANATION.

Winds in the lower Air, from a Surge. The Generation of these Winds in the lower Air, proceeds after this plain manner. The Air newly made of attenuated and rarified Water and Vapour, being added to the former Mass of the Air, the whole can now no longer be contained in the same Bounds ; but increases, and rolls onwards, still possessing a greater Space. Tho this depends upon two Suppositions ; viz. (1.) that a Drop of Water, converted into Air, requires at least a hundred times more Space than before ; and, (2.) that a little new Air in motion, being superadded to the old Mass, disturbs and puts the whole in motion ; like a small Blast coming from a Pair of Bellows, or a Crack in the Window ; which give a Motion to all the Air of a Room, so as to disturb the Flames of the Candles.

The Generation of some Winds like those of Mists. 25. As Dews and Mists are generated, here in the lower Air, without being formed into Clouds, or reaching to the middle Region ; the Case is the same with many Winds.

Breezes, what. 26. A continual Breeze arises from the Sea and Waters ; and this Breeze is nothing more than a faint Wind, newly generated.

The Rainbow sometimes resolved into Wind. 27. The Rainbow, which seems the lowest of all the Meteors, and generated near the Earth, is resolved into Winds, as much as into Rain, if not more, when it appears not entire, but shortned at the Ends, or broken.

Some Winds generated below the Tops of Mountains. 28. Some Winds have been observed, in Countries separated by the interposition of Mountains, to blow familiar on one side of those Mountains, without coming to the other : whence 'tis plain, that such Winds are generated below the Tops of those Mountains.

Winds in fair Weather. 29. There are numberless Winds which blow in fair Weather, and in Countries where it never rains : these Winds are generated where they blow, without having been Clouds, or ever reaching so high as the middle Region of the Air.

An indirect Phenomenon.

Winds generated thro' the whole Height of the Atmosphere. Whoever considers, how easily Vapour is convertible into Air ; how great a Quantity of Vapour there is in the World ; how much larger Space a Drop of Water turned into Air possesses than before ; and how greatly Air resists, upon but a moderate Compression ; can make no question that there must be Winds every where generated, from the Surface of the Earth to the Top of the Atmosphere : for 'tis impossible that a large Quantity of

of Vapour, when it begins to expand, should be raised to the middle Region of the Air, without furcharging the Air, and tumultuating in the way ▽.

S E C T. VIII.

Of the accidental Productions, or Generations, of WINDS; with regard to the eighth Article of the Table of Enquiry.

TRANSITION.

WE call those *accidental Productions of Winds*, which do not originally produce, or beget an impulsive Motion of the Wind; but either increase this Motion by Compression, return it by Reflection, or cause it to agitate and roll by Fluctuation: which proceeds from external Causes, and the Position of contiguous Bodies. *Accidental Productions of Winds, what.*

1. In Places where there are low Hills, with Vallies sinking about them, and again, higher Mountains rising beyond these Vallies, the Air is more agitated, and the Wind more perceived, than either on Mountains or Plains. *Winds most perceived in Vallies.*

2. Winds and Breezes are perceived in Towns and Cities, at the meeting of two Streets; or where any wide Place runs out into a narrow Slip; and in the publick Passages near great Buildings. *Winds, where most found in Cities.*

3. Cool Rooms are made in Houses, or happen accidentally by a Stream of Air passing thro' them, entering on one side, and going out at the other; but this is done more effectually when the Air enters in different Directions, meeting in Angles, and having a common Exit in one Corner. So likewise the Arching of Dining-rooms, or making them of a spherical Figure, contributes much to their Coolness; because, in this Case, the Air is moved and reflected in all Directions. So again, winding Porches are cooler than such as run strait; for a Blast in a strait Line, tho not confined, but having a free Exit, does not give such an unequal rolling, and undulatory Motion to the Air, as the meeting in Angles, turning short, winding about, rolling round, and the like. *Cool Rooms.*

4. After great Storms at Sea, the accidental Wind continues for a time, tho the original Wind be laid; as proceeding from a Collision and Percussion of the Air, by the Undulation of the Waves. *Accidental Winds, after Storms at Sea.*

5. The Wind, in Gardens, is commonly observed to be beat back by the Walls, the Building, and the Banks; so as to make one imagine that it blows in a contrary Direction to what it really does. *Winds in Gardens.*

6. If Hills inclose one side of a Country, and the Wind blow for some time against them from the Plain, the Wind, by the bare Repercussion it sustains, *Winds beating against Hills.*

O o o 2

sustains, is either condensed into Rain, if it be a moist Wind, or turned into a contrary Wind for a small Continuance.

*Winds in
Capes.*

7. Sailors frequently observe the Wind to change, and vary, in the Windings of Promontories.

S E C T. IX.

*Of extraordinary WINDS, and sudden GUSTS; with
relation to the ninth Article of the Table of Enquiry.*

TRANSITION.

SOME Authors speak, and complain of *extraordinary Winds*; such as Hurricanes, Tornados, Fiery-winds, and several kinds of Whirlwinds; but they give no Description of the Thing itself; which ought to be derived from Annals, scattered History, and Journals of the Weather.

*Sudden Gusts,
how generated.*

1. Sudden Gusts never happen in a clear Sky; but are always attended with Clouds and Showers; so that there may justly seem to be, in this case, a certain Eruption, a Disposition of the Blast, and a Concussion of the Waters.

*Storms with
Fogs, violent
at Sea.*

2. Those Storms called Sea-monsters, which happen in misty, or foggy Weather, supporting themselves like a Pillar, are prodigiously violent, and dreaded at Sea.

*Larger Whirl-
winds uncommon.*

3. The greater Tornados, which whirl round to any considerable distance, and snatch up Things in their way, happen seldom; but the lesser, or sportful Whirlwinds, are more frequent.

*The Procedure
of Hurricanes.*

4. All Hurricanes, Tornados, and the greater Whirlwinds, have a manifest, precipitate, or vibrating Motion downwards, more than other Winds; so that they seem to rush, like a Torrent, and flow down, as in a Channel; and afterwards to be beat back by the Earth.

Whirlwinds.

5. It happens frequently, that Cocks of Hay are carried out of the Meadows into the Air, and thence thrown down again, like a Canopy. The same sometimes happens in Fields of Pease, or Corn, whilst the Crop is drying. So again, wash'd Linen, hung out to dry, is sometimes carried up by a Whirlwind, as high as the Tops of Trees or Houses; and this happens without any great Force, or Violence of Wind.

*Their manner
of Production.*

6. But sometimes these slight Whirlwinds play in a very narrow compass, and even in fair Weather; so that a Person on Horse-back, may see the Dust, or light Matters, taken up, and whirled round near him, without perceiving much Wind at the same time. And this, doubtless, happens, from contrary Breezes mutually repelling each other; and causing a Circulation of the Air by the Shock.

7. 'Tis

7 Storms at Sea, are rare in foggy Weather.

7. 'Tis certain, that some Winds leave behind them, manifest Signs of Burning and Scorching, on the Plains and Plants they pass over; but for the Buſiness of fiery Winds, which are a kind of blind Lightning, or boiling Air, without Flame; it properly belongs to the *Enquiry of Thunder and Lightning* ^{of Burning Winds.}.

S E C T. X.

Of the Things contributing to Original WINDS; in pursuance of the tenth Article of the Table of Enquiry.

T R A N S I T I O N.

WHAT the Ancients have delivered upon the Subject of Winds, and their *Cauſes*, is very confused, doubtful, and but seldom true. No wonder any one should not see clearly who stands remote. They speak as if the Wind was something different from Air in Motion; as if Exhalations generated, and made up the whole Body of the Winds; as if the Matter of the Winds were only a hot and dry Exhalation; and lastly, as if the Origin of the Motion of the Winds, was only a Precipitation and Percussion, from the Cold of the middle Region. All which are but arbitrary Hypotheses, and Creatures of the Imagination; and yet, from such Threads as these, they have wove large Webs, in imitation of the Spider. But to consult Nature upon the Point; (1.) every Impulse of the Air makes a Wind; (2.) the Exhalations mixed with the Air, contribute more to the Motion than to the Matter of Winds; (3.) moist Vapours are, by a proportionate Heat, easier resolved into Wind than dry Exhalations; and, (4.) numerous Winds are generated in the lower Region of the Air; and many breathe out of the Earth; besides those which are drove back, and thrown down from above.

1. We observed, under the *Article of general Winds*, that the natural Rotation of the Air, without any other external Cause, produces a perceptible Wind within the Tropicks, where the Air revolves in larger Circles.

The ancients Doctrine of Winds imperfect.

2. Next to this natural Motion of the Air, before we proceed to enquire concerning the Sun, which is the principal Parent of the Winds; we must see whether any thing may, from clear Experience, be attributed to the Moon and the Stars.

Whether the Moon and Stars contribute to the Winds.

3. Great and strong Winds rise some Hours before an Eclipse of the Moon; so that if the Moon be eclipsed at Midnight, the Winds blow the same Evening: but if the Eclipse of the Moon happen in the Morning, they blow the Midnight before.

Influence of the Moon's Eclipse upon Winds.

4. *A 9th.*

² See more to this purpose in Mr. Bohun of Winds,

Of the Full-Moon.

4. *Acoſta* obſerves, that in *Peru*, which is a very windy Country, the Winds blow moſt at the Full-Moon.

PRECEPT.

The Effects of the Moon upon the Air to be noted.

It well deſerves to be obſerved, what Effects the Motions and Changes of the Moon have upon the Winds; ſince they certainly have one upon the Waters: as for Example, whether the Winds are not ſomewhat more boiſterous in the New and Full-Moon, than in the Quarters; the Tides being affected in the like manner. For altho it may ſeem a commodious Hypotheſis, that the Moon rules over the Waters; but the Sun and Stars over the Air; yet 'tis certain, that Water and Air are very homogeneous Bodies; and that, next to the Sun, the Moon has here the greateſt Power below.

Winds at the Planets Conjunctions. At Orion's Riſing.

5. 'Tis obſerved, that the greateſt Winds blow about the time of the Conjunctions of the Planets.

6. Storms and Tempeſts frequently happen at the Riſing of *Orion*: but it muſt be here examined, whether this happens not becauſe that Conſtellation riſes at the time of year moſt diſpoſed to produce Winds; ſo as rather to be a *Concomitant* than a *Cauſe*. And the ſame Queſtion may juſtly be put, as to the Riſing of the *Pleiades*, with regard to Showers; and of *Arcturus*, with regard to Storms^a. And ſo much for the Moon and Stars.

The Sun cauſes many Winds.

7. Doubtleſs the Sun is the primary Efficient of many Winds; as operating by his Heat upon two kinds of Matter; viz. the Body of the Air, and upon Vapours or Exhalations.

The Sun cauſes the Breezes between the Tropicks.

8. The Sun, when powerful, expands even pure Air, perhaps a third part; which is conſiderable: whence, by ſimple Expansion, ſome Breeze muſt neceſſarily ariſe in the Path of the Sun; eſpecially in the times of greateſt Heat: and this rather two or three Hours after the Sun is up, than in the firſt of the Morning^b.

The Nights, whence ſultry.

9. In *Europe*, the Nights are ſultry; but in *Peru*, the three firſt Hours of the Morning: and both for the ſame Reaſon; viz. becauſe the Winds and Breezes ceaſe at thoſe Hours.

Air made to act as Wind.

10. In a Water-Thermometer, the dilated Air depreſſes the Water, as if it were by a Blaſt; but in a Glaſs filled only with Air, and capt with a Bladder, the Air, when dilated, blows up the Bladder, like a manifeſt Wind.

Air put in motion by Heat.

11. We made an Experiment as to this kind of Wind, in a round Turret, cloſe ſhut up on all ſides; by placing in the miſt thereof a Chafing-diſh of Coals, thoroughly ignited, to prevent their ſmoking. On one ſide of the Chafing-diſh, at ſome diſtance, we ſuſpended a Thread furniſhed with a Croſs of Feathers, that it might be the more ſuſceptible of Motion; and now, when the Heat was increaſed, and the Air expanded, the Feather Croſs, with

^a It will come to be conſidered, whether the Riſing of the Conſtellations here mentioned, be meant of their *coſmical* or *acronical* Riſings; and whether the Signs of this kind are not rather *prætical* than *natural*.

^b See Dr. *Jurin's* Appendix to *Varenius*, pag. 37, 38.

with its String, appeared to be agitated, and moved about various ways: then, making a Hole in the Window of the Turret, there issued out a warm Exhalation; not in a continued Stream, but by fits, in an undulating manner.

12. So, likewise, the Condensation of the Air by Cold, after having been dilated, creates the same kind of Wind; tho weaker, by reason of the lesser Force of the Cold. And hence, in *Peru*, there is not only a greater Coolness perceived under every little Shade than here with us; but also a manifest Breeze, from the shrinking and contracting of the Air, when it enters the Shade. And thus much for Wind caused by a mere Dilatation, and Contraction of the Air.

13. The Winds proceeding from the mere Motions of the Air, without any Mixture of Vapour, are soft and gentle. We must next examine into the *vaporous Winds*, or those produced from Vapour; which may prove as much stronger than the former, as the Expansion of a Drop of Water turned into Air, exceeds the Expansion of Air, already produced; which it does by many degrees, as we before observed^c.

14. *Vaporous Winds*, which are those that commonly blow, are caused by the Sun with its proportionate Heat; and the Matter of them are Vapours and Exhalations, converted and resolved into actual Air; tho not quite perfect at its first Formation.

15. A small Heat of the Sun raises but little Vapour; and therefore causes but little Wind.

16. A moderate Heat of the Sun raises Vapours, and does not presently disperse them again; so that, if the Quantity thereof be large, they collect into Rain, either alone, or attended with Wind; but if the Quantity be small, they are turned into simple Wind.

17. The Heat of the Sun, upon its Increase, has a greater tendency to the Production of Wind; but in its Decrease, to the Production of Rain.

18. A strong and continued Heat of the Sun, rarifies, disperses, and sublimates the Vapours; at the same time mixing them equably, and incorporating them with the Air: whence the Air becomes calm and serene.

19. A more equable and continued Heat of the Sun, is less disposed to produce Winds; but an unequal, and changeable Heat, is more disposed to produce them. Whence Sailors, in a *Russia* Voyage, are less exposed to Winds than in the *British* Channel, because of the long Days; but in *Peru*, under the Equinoctial, the Winds come thick; by reason of the great Inequalities of Heat between the Day and Night.

20. Both the Quantity and Quality of Vapours must be regarded. A small Quantity produces gentle Gales; and a middling Quantity stronger Winds; but a large one over-loads the Air, and produces Rain either attended with a Calm, or Wind.

21. Vapours arising from the Sea, Rivers, and Lands overflowed, produce a much greater Quantity of Wind, than terrestrial Exhalations; but the Winds

^c Let the proper Use be here made of the *Æolipyle*; and the proper Experiments tried, in imitation of Nature, for turning Water, if possible, into true and permanent Air.

Winds that arise from the Earth, and drier Places, are more obstinate and durable; and prove, generally, such as are thrown from above: so that the Opinion of the Ancients has its Use in this respect; only they thought fit to divide the Right, and assign Rains to the Vapours, and nothing but Exhalations to the Winds; with the like Distributions; which look pretty in Discourse, tho they are but empty at the Bottom.

*The Winds
from melted
Snows.*

22. Winds proceeding from the melting of Snow upon the Tops of Mountains are of a middle Nature, betwixt aquatick and terrestrial Winds; but they rather incline to the aquatick: being, however, more sharp and active.

23. We formerly observed, that the melting of Snow upon the snowy Mountains, always produces Stated Winds on the side where it melts.

24. So likewise the anniversary North Winds, that happen about the Rising of the Dog-Star, are thought to proceed from the Frozen-Sea, and the Parts about the Artick-Circle; where Thaws happen late, or when the Summer is advanced.

From Ice.

25. The huge Masses, or Mountains of Ice, carried down towards *Canada* and *Newfoundland*, rather produce certain cold Breezes, than variable Winds.

From Sands.

26. The Winds that blow from chalky and sandy Lands, are few and dry; but, in the hotter Countries sultry, suffocating and scorching.

*From Sea-Va-
pours, and
Land-Exhala-
tions.*

27. The Winds arising from Sea-Vapours, easily fall back again into Rain, or the Water whereof they were made; or, if they do not this, they soon mix along with the Air, and grow quiet: but terrestrial, smoky and unctuous Exhalations, are resolved with greater difficulty, mount higher, are more irritated in their Motion, frequently enter the middle Region of the Air, and help to compose the Matter of fiery Meteors.

*Winds from
burning Vege-
tables.*

28. 'Tis reported here in *England*, that at the time when *Gascony* was under our Jurisdiction, the Subjects of *Bordeaux*, and the neighbouring Parts, petitioned the King, that the burning of Heath might be prohibited in *Suffex*, and *Hampshire*; because it produced a Wind about the end of *April*, destructive to their Vines.

*The meeting
of Winds.*

29. The meeting of strong Winds one against another, produces violent Whirlwinds; but if they are only gentle and moist, their meeting produces Rain, and a Calm.

*Winds allay'd
five ways.*

30. Winds are checked and allay'd five ways; viz. (1.) when the Air, loaded and tumultuating with Vapours, is freed from them by their contracting themselves into Rain; (2.) when the Vapours are rarified, dissipated, and so mixed kindly in along with the Air, and grow quiet there-with; (3.) when the Vapours, or Exhalations, are raised up, or sublimed, to a great height; so as to acquire a state of Rest, till they either penetrate the middle Region of the Air, or are thrown down by it; (4.) when Vapours, collected into Clouds, are carried into other Countries by Winds blowing from on high, so as not to disturb the Countries over which they pass; and, (5.) when the Winds blowing from their Origins, continue their Motion a long way, without any new Supply of Matter; but at length slacken, lose of their Force, and sink of course.

31. Showers

31. Showers generally allay the Winds; especially such Winds as are stormy: and Winds, on the other hand, frequently keep up Showers.

Showers and Winds prevent each other. Winds, how turned into Rain.

32. Winds contract themselves into Rain, (1.) either by being oppressed with Weight, when the Vapours are copious; or, (2.) by means of the contrary Motions of gentle Winds; (3.) by the Obstruction of Mountains and Promontories, which stop the Force of the Winds, and gradually turn them back upon themselves; and, (4.) by intense Cold, which condenses them. And this Contraction into Rain, is the first and principal of the five Ways whereby Winds are laid^d.

33. The smaller and more gentle Winds generally rise in the Morning, and fall when the Sun sets; the nocturnal Condensation of the Air being sufficient to contract them: for Air will suffer some degree of Compressure without any great Reluctance.

Winds rising and falling with the Sun.

34. The ringing of Bells is thought to dissipate Thunder and Lightening; but the same is not observed as to Winds^e.

Whether ringing of Bells may allay Wind.

35. *Pliny* relates, that the Violence of a Whirlwind may be broke by the playing of Vinegar in amongst it.

Whirlwinds laid by Vinegar.

ADMONITION.

Let the Prognosticks of Winds be here consulted; for there is some Connexion between Causes and Signs.

Prognosticks of Winds to be considered.

SECTION. XI.

Of the Limitations of the WINDS; in pursuance of the eleventh Article of the Table of Enquiry.

1. **T**IS related of *Mount Albo*, and *Mount Olympus*, that the Priests who yearly sacrificed upon their Tops, used to find the Writing they had drawn in the Ashes of the Sacrifice one Year, no way disordered or obliterated, when they returned the next; altho these Altars did not stand in a Temple, but in the open Air: whence it was manifest, that at such a height there fell no Showers, and blew no Winds^f.

Winds reach not to the Tops of some Mountains.

2. They relate, that on the *Pike of Teneriff*; as also upon the *Andes*, betwixt *Peru* and *Chili*; there lies Snow along the Cliffs and sides of the Mountains; whilst upon the Tops thereof the Air is quiet; but so subtil as hardly to suffice for Respiration; and so acrimonious and pungent as to inflame the Eyes, and give a Nausea to the Stomach.

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3. Va-

^d See above, § 30.

^e It is reported, that stormy Winds are frequently laid by the firing of Cannon, in Sea-Fights.

^f See hereafter Sect. XIV.

*Vaporous
Winds not
high.*

3. Vaporous Winds seem not to blow at any great height ; tho 'tis still probable that some of them ascend higher than most Clouds.* And so much for the Height ; next for the Breadth of Winds.

*The Breadth of
Winds.*

4. 'Tis certain, that the Spaces possessed by Winds are very various ; being sometimes extremely wide, and sometimes small and narrow. They have been found to range a hundred Miles in a few Hours.

*Spreading
Winds not vio-
lent.*

5. Diffusive Winds, if free, are generally vehement, and durable ; commonly continuing twenty-four Hours ; but not rainy. On the contrary, narrow, or confined Winds, are either gentle, or stormy ; but always short-lived.

*Stated Winds
travel far.
Stormy Winds
confined.
Sea-Winds
confined.*

6. Stated Winds are itinerant ; and travel over vast Spaces.

7. Stormy Winds run not out far ; tho always beyond the Limits of the Storm itself.

8. Sea-Winds blow within much narrower Bounds than Land-Winds ; infomuch, that at Sea they sometimes observe a brisk Gale driving the Waters on one side ; as appears by the ruffling and curling thereof ; whilst every where else there is a Calm ; and the Sea remains as flat as a Looking-glass.

*Little Whirl-
winds very
confined.*

9. We before observed, that little sportful Whirlwinds sometimes play with the Dust upon the Road, like the Blast of a Pair of Bellows. And so much for the *Extent* of the Winds : next for their *Duration*.

*Strong Winds
continue longer
at Sea than
Land.*

10. Very strong Winds at Sea continue for a long while ; as there receiving a large Supply of Vapour : but at Land, they scarce continue above a Day and a half.

*Gentle Winds
variable.
Morning*

11. Very gentle Winds continue not to blow constantly, for above three Days, either at Sea or Land.

*Winds last the
longest.*

12. The East Wind, we before observed, is more lasting than the West ; and whatever Wind begins to blow in the Morning, usually continues longer than that which rises in the Evening.

*strong Winds
fall suddenly.*

13. 'Tis certain, that Winds rise and increase by degrees, unless when they are perfectly stormy ; but fall quicker, and sometimes all at once.

S E C T. XII.

*Of the Successions of the WINDS ; with regard to
the twelfth Article of the Table of Enquiry.*

*The Wind sel-
dom retro-
grade.]*

I. **W**HEN the Wind changes conformably to the Motion of the Sun ; that is, from East to South ; from South to West ; from West to North ; and from North to East ; it seldom goes back ; or if it does 'tis only for a short time : but if it moves in a contrary Direction ; viz. from East to North ; from North to West ; from West to South ; and from South

* Which is seldom high ; or much above half, or a quarter of a Mile, as has been often measured.

South to East ; it generally returns to the former Point, at least before it has gone thro' the whole Circle.

2. If Rain comes first, and the Wind begins to blow upon it, the Wind continues longer than the Rain ; but if the Wind blow first, and is afterwards laid by the Rain, the Wind seldom returns ; or if it does, it also rains afresh.

The Succession of Wind and Rain.

3. When Winds continue to vary for a few Hours, as if it were to try in which Point they should settle, and afterwards begin to blow constant ; they continue for many Days.

Varying Winds, coming to settle, are constant

4. If the South Wind begins to blow for two or three Days, the North Wind will sometimes blow suddenly after it : but if the North Wind blows for the same Number of Days ; the South Wind will not rise till after the East has blown a while.

The East Wind interposes between the North and South Wind.

5. When the Year is upon the Decline, and Winter coming on ; if the South Wind blow at the beginning of the Winter, and afterwards the North ; the Winter will prove frosty : but if the North Wind blow at the beginning of the Winter, and afterwards the South ; the Winter will be mild and warm.

The State of the Winter prognosticated by the succession of Winds.

6. Pliny relates, from Eudoxus, that Winds return in the same Series every four Years : which seems no way true ; for the Revolutions of the Winds are not so quick. But the diligence of some has reached so far as to observe, that the greater and more remarkable Changes, such as Heats, Snows, Frosts, warm Winters, and cold Summers, generally return in a Circle of thirty Years.

Revolutions of Wind and Weather.

S E C T. XIII.

Of the Motions of the WINDS ; in pursuance to the thirteenth Article of the Table of Enquiry.

I.

TRANSITION.

MEN express themselves as if the Wind were a certain Body, that, of itself, impelled, and drove the Air before it, by its own Force ; and when it changes, they speak as if the Wind had removed itself to another Place : and, whilst the Populace talk in this manner, Philosophers do not correct such Notions ; but, instead of stopping the Error, give somewhat into the same themselves.

Authors speak inaccurately of the Winds.

1. Having, therefore, already enquired into the local Origins of Winds ; we are next to enquire into the Excitation and Direction of their Motion. And for the Winds which have their Motion begun in their first Impulse ;

The Excitation and Direction of Winds.

as those have which are thrown down from above, or breathe out of the Earth; the Excitation of their Motion is manifest: but others descend, and some ascend in their Beginning; and afterwards acquire a rolling Motion, from the Resistance of the Air; chiefly according to the Angles wherein their Force is directed. But for such as are produced every where in the lower Part of the Atmosphere, as the commonest Winds are, the Enquiry about them seems difficult and obscure, tho the Thing itself be but vulgar; as we observed in the *Explanation* under the seventh *Section* ^a.

The Experiment of producing Wind in a close Turret, varied.

2. We find some Resemblance of this Matter, in the close Turret mentioned above; for we varied our Experiment three ways: the first was that already mentioned ⁱ, with a Chafing-dish of Charcoal thoroughly ignited. The second was, by using a Vessel of hot Water, without the Chafing-dish; and then the Motion of the Feather-Cross was slower, and less active than before; the dewy Vapour of the Water now hanging in the Air, unresolved into the Matter of Wind, thro' the weakness of the Heat. The third Variation was made by continuing both the Chafing-dish and the Vessel of Water in the Room, and then the Cross was agitated much more than ever; so as sometimes to be tossed upwards in an Eddy, as if by a little Whirlwind; the Water now affording a Quantity of Vapour, and the Fire adjacent driving and dispersing it about ^k.

Cause of the Winds Excitation.

3. And therefore a principal *Cause* of the Excitation of the Wind's Motion, is the surcharging of the Air, by a new Addition of Air produced from Vapours. We proceed next, to the Direction of the Wind's Motion; or its *Verticity*, which is its change of Direction.

Its progressive Motion from Nurseries or Springs.

4. The Direction of the Wind's progressive Motion is governed by the *Nurseries*, which serve as Fountains to Rivers; viz. such Places as contain a larger Collection of Vapours; and are as the native Country of Winds. But when they find a Current, or meet with little Resistance from the Air, then, like Water in a Declivity, they receive and sweep away all the light Matter they find in their Course, and mix it with their own Stream, after the manner of Rivers: and therefore Winds always blow from the Quarter where their Springs or Nurseries lie.

Winds without Nurseries easily vary.

5. When the Winds have no remarkable *Nurseries* in a certain Place, they change, or wander about extremely; and easily alter their Current; as in the middle of the Sea, and wide extended Plains.

Whence Winds blow differently strong.

6. When there are great Nurseries of Winds in one Place, but the Winds receive small Additions from the Places they pass thro', they blow strong at the Beginning; and flag by degrees: on the contrary, where their Nurseries are farther continued; they blow gently at first, and stronger afterwards.

Moveable Nurseries of Winds.

7. There are *moveable Nurseries* of Winds; viz. in the Clouds; which are frequently carried by the Winds that blow aloft, into Countries very distant

^a See Page 468.

ⁱ See above, pag. 472. § 11.

^k Experiments of this kind might easily be contrived and made; so as to give great Light and Information in many Parts of the present Subject.

distant from the Origin of those Vapours that produced the Clouds: and in this case the Nursery of the Wind begins on that side, where the Clouds begin to resolve into Wind.

8. But the *Fertility*¹ of the Winds does not happen, because the Wind transports itself in blowing; but because it is either laid of itself, or subdued by another Wind: and this whole Affair depends upon the various Situations of the Nurseries of Winds, and the Varieties of Times and Seasons wherein the Vapours issuing from these Nurseries are resolved.

The Fertility of Winds, whence.

9. If there are Nurseries of Winds in opposite Points; as one to the South, another to the North; the stronger Wind will prevail, and blow constant, without any contrary Wind appearing; yet so as to be somewhat checked and deaden'd by the weaker Wind; as the Tide is by the Course of a River, where the Motion of the Sea prevails; tho it be somewhat resisted by that of the River. But if one of the two contrary Winds, which at first was the stronger, happens to fall; the other will now suddenly blow in its own contrary Direction, wherein it blew before; tho it lay concealed under the Power of the stronger.

From opposite Nurseries.

10. So, for Example, if there be a Nursery of Wind to the North-East; the North-East Wind will then blow: but if there be two Nurseries, the one to the East, and the other to the North; the two respective Winds will blow separate, for a certain Tract; but, after their *Angle of Confluence*, they will blow North-East; or vary from that Direction, according as one Nursery proves stronger than the other^m.

How the Winds blow from different Nurseries.

11. If there be a strong Nursery of Wind to the North, at twenty Miles distance from any Country, and a weaker to the East at ten Miles distance; the East Wind will blow first, for some Hours; and soon after, when that has run its Course, the North.

Winds change their Direction according to their Obstacles and Reflections.

12. If the North Wind blow, and meet a Mountain in its way, from the West; it will soon after blow North-East; or a Blast compounded of the original and the reflected Wind.

13. If there be a Nursery of Winds in the Earth, to the North, and the Blast go right upwards, and meet a cold Cloud from the West, which reflects it to the opposite Point; it will blow North-East.

ADMONITION.

In the Earth and Sea the Nurseries of Winds are stable; so that their Spring and Origin may here be the better perceived: but being moveable in the Clouds, the Matter of them may be supplied in one Place, and the Winds formed in another; which occasions the Direction of their Motion to be more confused and uncertain. The Cases above produced are in the way of Examples, that may serve for all Cases of the like kind. And so much for the Direction of the *Winds Motion*: but for the *Courses or Voyages of the Winds*; tho we have touched upon them before, under the Title of

Some Nurseries of Winds stable, others moveable.

¹ See above, § 3.

^m According to the common *Laws* of Motion and Hydrostaticks.

The HISTORY of the WIND.

of the *Breadth of the Winds*, we must here enquire a little farther into them ; since the Breadth of the Winds may be unskilfully taken for their Length, if they should prove wider than they are long, in their Sweep or Progression.

*That Winds
may have a
long Course.*

14. If it were true, that *Columbus* could form a Judgment of the Continent of *America* from the stated western Winds on the Coast of *Portugal* ; it would be certain that the Winds might take a very long Journey.

15. If it be true, that the thawing of the Snows about *Scandia* and the *Frozen-Sea*, raises a North-Wind in *Italy*, *Greece*, &c. in the Dog-days, 'tis a very long way for Winds to travel.

16. It has not hitherto been observed how much sooner, in order of the Wind's Motion, a Storm comes to any Place from one Quarter, than from another : for Example, how much sooner from the East ; with the Wind at East ; than from the West. And so much for the *progressive Motion* of the Winds : we come next to their *Undulation*.

*The Undula-
tion of the
Winds.*

17. The Winds undulate quick ; so that even a strong Wind fluctuates, or rises and falls alternately, at least a hundred times in an Hour ; which shews the Force of the Winds to be interrupted : whereas Rivers, tho rapid ; and Currents of the Sea, tho strong ; have no Undulation, except from the Winds. Nor is this Undulation of the Winds any way equable ; but, like the Pulse, sometimes intermits, and sometimes returns double.

*The Difference
between the
Undulation of
the Winds and
Waters.*

18. The Undulation of the Air differs from that of Water in this, that in Water, after the Waves are risen they fall again spontaneously, to a Flat : so that, notwithstanding the lofty poetical Descriptions of Tempests raising the Waves to the Skies, and sinking them again to the Abyss ; there is no considerable Descent perceived of them, below the level Surface of the Water : but in the Undulation of the Air, where the Motion of Gravity is less, the Air is raised and depressed almost equally. And so much for the *Undulation of the Winds* : next for their *Motion of Conflict*.

*Conflicts and
compound Cur-
rents of Winds.*

19. We have already made some Enquiry into the *Conflicts* and *compound Currents of the Winds*. 'Tis manifest that Winds, especially the gentle ones, blow indifferently any where ; there being few Days or Hours wherein some gentle Breezes are not perceived in open Places ; and that with great Inconstancy and Variety : for those Winds which proceed not from any larger Nursery, wander and roll about, as if sporting with each other ; sometimes meeting, and sometimes disjoining, and flying asunder.

*Contrary
Winds meeting
at Sea.*

20. Two contrary Winds are sometimes observed to meet at Sea ; as appears from the rustling of the Surface of the Water on either side of the Ship ; and the stillness of the Water in the middle : and after the Shock there one while ensues a general Calm on the Water ; that is, when the Winds equally break each other on both sides ; and another while, a continued struggle and agitation of the Water ; when the stronger Wind prevails.

21. The Winds are certainly often observed to blow one way on the Mountains of *Peru* ; and, at the same time, a contrary way in the Vallies *Winds blowing contrary ways at once.* below.

22. 'Tis likewise certain, that the Clouds, here with us, are driven one way, whilst the Wind blows another.

23. Again, 'tis certain, that the higher Clouds are sometimes found to fly over the lower ; so as to go different, and even contrary ways ; like opposite Currents.

24. 'Tis likewise certain, that there is sometimes a Calm aloft in the Air ; whilst a rude Storm blows below, for the space of half a Mile.

25. On the other hand, there is sometimes a Calm below, whilst the Clouds move brisk above ; tho this happens but seldom.

26. Nor should the Testimony of *Virgil* be wholly omitted ; as he had some Notion of *Natural Philosophy*. He makes the *East*, *South-West*, and *West* Wind blow at once ; and again, all the Winds to combat together .

An indirecť Phænomenon.

It happens also in Waves, that sometimes the upper, and sometimes the lower Water moves the quickest ; and sometimes, tho rarely, there are found two different Currents of Water, one above and another below, moving in contrary Directions. And thus much for the *natural Motions* of the Winds : we next proceed to their *Motions in artificial Machines* ; but principally in the Sails of Ships.

II.

Of the Motion of the Winds, in the Sails of Ships.

1. **W**E here chuse, for our Example, the largest *British* Ships, which have four and sometimes five Masts, all standing erect, in a strait Line, one behind another, along the middle of the Ship. Their Names are the *Main-Mast*, which stands in the Centre ; the *Fore-Mast*, the *Mizzen-Mast*, which is sometimes double ; and the *Bow-sprit*. *The Masts of the English Men of War.*

2. Each Mast consists of Pieces, which may be cramp't and joined to each other ; and again taken down at pleasure : some have three, others but two of these Pieces. *The Masts have several Pieces.*

3. The *Bow-sprit* stands inclined to the Sea from its lower Juncture ; but from its upper, erect : and all the other Masts stand perpendicular. *The Position of the Masts.*

4. These Masts are rigged with ten Sails ; and when the *Mizzen-Mast* is double, with twelve. The *Main-Mast* and *Fore-Mast*, have three Tier of Sails *The Sails.*

* *Unde Eurus, Notusque ruunt, creberque procellis
Africus.*

Omnia Ventorum concurrere Prælia vidi.

Sails; which we call the *Main-Sail*, the *Top-Sail*, and the *Main-top-Sail*. The other Masts have only two Sails, without a *Main-top-Sail*.

The Position of the Sails.

5. The Sails are spread a-crofs, near the Top of each Joint of the Mast, by means of certain Rods, or Yards, to which the upper-part of the Sail is fixed; the Bottom is tied with Ropes only at the Corners; the *Main-Sail's* being thus fastened to the sides of the Ship; and the *Main-top-Sails* to the Yards, immediately below them. And by the same Ropes they are shifted, or turned, to either side, at pleasure.

The Yards.

6. The Yard of every Mast goes athwart the Mast; only those of the Mizzen Mast hang aslope; the one end being elevated, and the other depressed: but in the rest they make right Angles with the Mast.

Figure of the Sails.

7. The Sails of the *Main-Mast*, *Fore-Mast*, and *Bow-Sprit*, are of a quadrangular, or parallelogram Figure; but the Top and *Main-top-Sails* rise somewhat narrow; whilst the *Main-Sail* of the Mizzen-Mast is triangular; and the *Top-sail* sharp or pointed.

The Measure

of the Main-Sail, of the Main Mast. Top-Sail of the Main-Mast.

8. A Ship of eleven hundred Tun, a hundred and twelve Foot long in the Keel, and forty Foot wide in the Hold, carried the *Main-Sail* of its *Main-Mast* forty-two Foot, deep and eighty-seven Foot wide.

9. The *Top-Sail* of the same Mast was fifty Foot deep; eighty-four Foot wide at the Basis; and forty-two at the Top.

Main-top-Sail.

10. The *Main-top-Sail* was twenty-seven Foot deep, forty-two Foot wide at the Basis, and twenty-one at the Top.

Fore-Mast Main-Sail.

11. The *Main-Sail* of the *Fore-Mast* was forty Foot and an half deep, and seventy-two Foot wide.

Top-Sail.

12. The *Top-Sail* of the same Mast was forty-six Foot and a half deep, sixty-nine Foot wide at the Basis, and thirty-six a-top.

Main-top-Sail.

13. The *Main-top-Sail* of the same Mast was twenty-four Foot deep, thirty-six Foot wide at the Basis, and eighteen a-top.

Mizzen-Main-Sail.

14. The *Mizzen-Main-Sail* was fifty-one Foot deep, from the elevated Yard-Arm, and seventy-two Foot wide where it joins to the Yard; the other part ending sharp.

Top-Mizzen-Sail.

15. The *Top-Mizzen-Sail* was thirty Foot deep, fifty-seven Foot wide at the Base, and thirty a-top.

If two Mizzen-Sails.

16. If there be two *Mizzen-Masts*, the Sails of the hindmost are less, by about a fifth part, than those of the foremost.

Main-Sprit-Sail.

17. The *Main-Sail* of the *Bow-Sprit* was twenty-eight Foot and a half deep, and sixty Foot wide.

Top-Sail.

18. The *Top-Sail* thereof was twenty five Foot and a half deep, sixty Foot wide at the Base, and thirty a-top.

Proportion of the Masts and Sails variable.

19 The Proportions of the Masts and Sails of Ships vary, not only with the Rate or Size of the Ship, but also according to the different Uses for which they are built; as whether for Fight, Freight, Swift-sailing, &c. But there is no manner of correspondence between the Dimensions of the Sails, and the Ships Burden, or number of Tuns she carries; for a Ship of about five hundred Tuns carries the *Main-Sail* of its *Main-Mast* but a few square Feet less than another of twice the Burden. Whence it is, that
small

small Ships are much better Sailers than the larger ; not only because of their Lightness, but also because of the Largeness of their Sails, with respect to the bulk of the Ship : for it would be an unwieldy and impracticable thing, to preserve this Proportion in the larger Shipping.

20. As all the Sails are stretched full out at their Tops, and fasten'd only by their Corners at the Bottom ; the Wind must of necessity swell the Sails ; especially towards the Bottom, where they are slackest. *Whence the Sails swell.*

21. This Swell of the Sails is much greater in the Main-Sails, than in the rest ; not only because those Sails are Parallelograms, and the others narrower upwards, or pointed ; but again, because the width of the Yard far exceeds the width betwixt the Ship's two sides, to which 'tis fasten'd : whence, of necessity, these Sails yield, by their Slackness, a large Bottom to the Wind ; inasmuch, that in the great Ship we have chose for our Example, this Swell, in sailing before the Wind, may bulge out nine or ten Foot from the Plain of the Sail. *Greatest Swell in the Main-Sail.*

22. And for the same Reason, all Sails swelled with Wind, form themselves into an Arch, at the Bottom ; so that much of the Wind must necessarily miss them : and this Arch, in the great Ship above-mentioned, will, in its Height, equal the Stature of a Man. *Sails arch'd by the Wind.*

23. But in the triangular Sail of the Mizzen-Mast, the Swell must needs be less than in a quadrangular Sail ; as well by reason of the less capacious Figure, as because in a quadrangular Sail there are three Sides slack, and but two in a triangular one : whence the Wind is received more slyly in the triangular Sail.

24. The nearer the Wind's Motion comes to the Head of the Ship, the more powerful it proves, and sets her forward the faster ; because 'tis spent upon a Part where the Waves are easiest cut by the sharp Make of the Prow : but principally, because a Motion at the Head draws the Ship along ; whilst a Motion in the Stern only protrudes her. *A Wind near the Ship's Head powerful.*

25. The Wind's Motion in the higher Tiers of Sails, sets the Ship forwards more than in the lower Tiers ; because all strong Motions are most effectual, when far removed from the Resistance ; as we see in Levers, and the Sails of the Wind-mill : but for fear of over-setting the Ship, the higher Sails are made tapering, to prevent their carrying too much Wind ; and are chiefly used at such times when little Wind is stirring. *The upper Sails powerful.*

26. When Sails are placed in a strait Line, one behind another, the hindmost must necessarily take the Wind from the foremost, when it blows fore-right : and therefore, tho they were all spread at once, yet the Wind would have little Force upon any more than those of the Main-Mast ; and a little upon the Main-Sail of the Bow-Sprit. *Sails, why not placed in a strait Line.*

27. The most commodious and advantageous Disposition of the Sails before a Wind, is to hoist the two lower Sails of the Fore-mast ^P ; where, as we said, the Motion is the more effectual : and again, also the Top-Sail *The Sails, how best spread before a Wind.*

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Q q q

Sail

^P I. e. near the Ship's Head. See above § 24.

Sail of the Main-Mast^a; as there will still be left Space enough underneath, for the Wind to fill the lower Fore-sails, without robbing them too much.

*Why Ships
sail better
with a side
Wind.*

28. By reason of the Back-sails thus taking the Wind from the Fore-sails, a Ship makes more Way with a side Wind, than with a direct Wind; for in a side Wind, all the Sails may be crowded, without taking the Wind from one another; as they all turn Side to Side.

*The best Wind
for sailing.*

29. Again, the Sails are stiffer stretched against a side Wind; which stretching somewhat compresses the Wind, and directs it to the Part where it should blow: whence it acquires some additional Strength. But that Wind is the most advantageous which blows in the Quarter, between a fore Wind and the side one^r.

*The Main-
Bow-Sprit-
Sail seldom
useless.*

30. The Main-Sail of the Bow-Sprit can scarce ever prove useless; as being not liable to be robbed of its Wind; which it receives from that blowing every way about the Ship-sides, and under the other Sails.

*An Impulse,
and a Direc-
tion, in sail-
ing.*

31. In the Motion of the Winds in Ships, there is observed both an Impulse, and a Direction: but that Direction which belongs to the Rudder, does not greatly concern the present Enquiry; only as it has a Connexion with the Motion of the Winds in the Sails.

TRANSITION.

*The Mizzen-
Main-Sail
assists the
Helm.*

As the Motion of Impulse is in vigour at the Head; so is the Motion of Direction at the Stern; and therefore the Main-Sail of the Mizzen-Mast, is of great moment to the Impulse; and proves, as it were, an Assistant to the Helm.

*Use of the
Mizzen-
Main-Sail in
unfavourable
Winds.*

32. As the Mariners-Compass is divided into thirty-two Points, so that each Semi-circle thereof contains sixteen; a Ship may sail in Progression, without Traversing, (as is usual in contrary Winds,) even tho of those sixteen Points, ten be opposite; and only six of them favourable: but this greatly depends upon the Main-Mizzen-Sail; for as the Points of the Wind now prevail which are contrary to the Ships Course, and cannot be governed by the Helm alone; they would turn the other Sails, and the Ship itself, a contrary Way; but that this Sail holding tort, favours the Helm, strengthens its Motion, and turns and brings about the Ship's Head into the Way of her Course.

*Winds load the
Ship.*

33. All Wind in the Sails, somewhat loads and sinks the Ship; and this the more, as it blows from aloft: and therefore, in great Storms, they first lower their Yards, and down with the Top-Sails; and next, if there be Occasion, down with all the rest; even cutting away the Masts themselves, and throwing their Guns, Lading, &c. over board; to lighten the Ship, and keep her floating, at the Mercy of the Waves.

34. With

^a See § 25.

^r Ships differ greatly in Sailing; according to accidental Circumstances in their Make, Trimming, &c. Thus some Ships that sail excellently with their Masts upright, will scarce sail at all with them reclined; and *vice versa*.

34. With a brisk and favourable Gale, even a Ship of Burden may sail a hundred and twenty *Italian* Miles in four and twenty Hours. There are certain Packet-Boats, wholly built for Sailing, that will make much more Way. But when the Wind is directly in their Teeth; as a last, tho feeble Shift to advance, they traverse, or cut away cros and cros, out of their Course; shifting their Sails as the Wind requires; then bend up towards their Course again: and thus by repeating these angular Trips, they get right forwards; tho perhaps but at the Rate of fifteen Miles in twenty-four Hours.

How fast a Ship may sail with a fair Wind.

Traversing.

Larger OBSERVATIONS.

1. **T**HIS Motion of the Winds, in the Sails of Ships, has three principal Origins, and Fountains of its Impulse, from whence it is derived; and from whence also, Rules may be formed for increasing and strenghtening it. *The Origins of the Impulse in Sailing.*

2. The first Fountain is, from the Quantity of the Wind received; for 'tis plain, that much Wind, here contributes more than a little; and therefore a sufficient Quantity of Wind must be carefully procured. The Means to procure it is, in the way of Thrift and good Husbandry, to prevent being robbed of it; and therefore, *as much as possible, let no Wind be lost, misemployed, or taken from the Ship.* *Affords Rules for increasing it.*

3. The Wind blows either above the Ship's sides, or below them, towards the Surface of the Sea; and as, in the way of good Husbandry, 'tis usual to be very careful of small Matters, (for every body takes care of large ones;) so a *particular regard must be had to these lower Winds*; tho they doubtless are of less Efficacy than the higher. *To save the low Winds.*

4. As for the Winds which play chiefly about the Ship's sides, and under the Sails; 'tis the true Office of the Main-Sail of the Bow-Sprit to prevent their being lost: this Mast standing low, and aslope, so that its Main-Sail may receive them; and therefore become serviceable, without taking from the Winds intended to fill the other Sails. And, with regard to this Point, we do not see what human Industry can do more; unless it were to *spread the wing-sails like kind of low Sails, in the manner of Wings, from the Middle of the Ship; two on both Sides; when the Wind blows fore-right.* *from the Ship's sides.*

5. In order to prevent the fore-Sails from being robbed by the back-Sails, in fore-right Sailing; there seems to be no other Method left, but to range the Sails in the Form of a pair of Steps, mounting upwards from Stern to Stem, so that the Sails of the Mizzen-Mast may hang the lowest, those of the Main Mast in the middle, and those of the Fore-Mast highest; whence one Sail will not hinder, but rather assist, and serve another; by giving and transmitting the Wind thereto. But this only holds good in sailing before the Wind; for in a side Wind, all the Sails co-operate. And so much for the first *Fountain of Impulse.* *To prevent the Sails from being robbed of their Wind.*

6. The second *Fountain of Impulse* arises from the manner wherein the Wind strikes the Sail; for if, thro' the Contraction of the Wind, the

The second Origin; the kind of Stroke.

Stroke be sharp and sudden, it will give the greater Motion ; but if diffused and languid, the less.

The Sails to be neither full stretched nor loose.

7. And with regard hereto, 'tis of very great moment that the Sails should receive but a moderate Swell and Extension : for if they be too tort, they will rebound the Wind, like a Wall ; and if too slack, the Impulse will prove weak.

The Success here not owing to Judgment.

8. And here human Industry has succeeded in some Particulars, tho rather by Chance than by Judgment ; for, in a side Wind, they contract that part of the Sail, as much as possible, which is opposite to the Wind ; and by this means throw the Wind into the other part, where they would have it blow. And this, indeed, they do by Design ; tho, perhaps, without considering that besides this, the Wind is at the same time necessarily contracted ; and so has a sharper Percussion.

Spur-fashion'd Sails.

9. What farther Improvement may here be made, we do not well perceive ; unless the Figure of the Sails were altered ; and some of them made not to swell spherical, but Spur-fashion ; with the Yard in the middle of the Bend : so that the Wind, being contracted towards a Point, might not only have a smarter Percussion ; but the Sail also the better cut the resisting Air.

And a Sail within a Sail.

And we know not what might be the Effect of having a Sail within a Sail ; that is, to fix a kind of Purse in the middle of a larger Sail ; and keep it astrut with splices of Wood ; so as to collect the Wind in the middle of the large Sail, and bring it to a kind of Point.

The third Origin, the place of Percussion.

10. The third *Fountain of Impulse*, proceeds from the Place where the Percussion is made ; and is of two kinds : for the Impulse is easier and stronger on the fore-part, than on the hind-part of the Ship ; and on the upper-part of the Masts and Sails, than on the lower.

Two or three Fore-Masts.

11. Nor do Men seem to have been ignorant hereof ; as laying the greatest stress upon the Sails of the Fore-Mast, in sailing before the Wind ; and spreading their Main-top-Sails in Calms. And we can think of no farther Improvement, at present, in this respect ; unless, as to the *first* Case, it be to have two or three Fore-Masts ; the middle one erect, and the others inclined, with their Sails hanging right-down ; and, in the *second*, to enlarge the Fore-Mast Sails, at the Top, or to make them less tapering than usual : but, in both Cases, so as to prevent all Danger from sinking the Ship too much.

III.

Of the Motion of the Wind, in other Machines of human Invention.

The Action of the Wind in turning Wind-Mills.

1. **T**HE Motion of a *Wind-Mill* has no difficulty in it ; and yet 'tis, usually, neither well demonstrated nor explained. The Sails are set directly facing the Wind that blows ; but one side of each Sail lies more to the Wind, whilst the other gradually slopes away from it. But the revolving Motion always begins from the lower Side ; which is farther removed from the Wind. And now the Wind, blowing against the Machine,

is compress'd by the four Sails; and obliged to take its Course thro' the open Spaces between them: whence the Wind, in this compress'd State, of necessity brushes smartly against the Edges of the Sails, and turns them round; as a Top, or the like, is turned, or set up, by a Flirt of the Finger.

2. If the Sails were stretched out equally, 'tis a Question which way they would incline; as in the falling of a Stick: but as the first Side that meets the Wind, throws the force of the Wind upon the lower Side; and this again throws it into the Vacuities; this lower Side receives the chief Impulse of the Wind; whence the Rotation presently begins on that Part: for 'tis not the first Impulse of the Wind in front^t; but a lateral Impulse, after the Compression, that begins the Motion.

How the Impulse is given.

3. To this Purpose we made several Experiments upon Paper-Sails, turned with the Blast of Bellows. (1.) And first, we added a Fold to the lower Side of the Sail turning away from the Blast, which now coming sideways, might have a larger Surface to strike against: but this had no good Effect; the additional Fold not assisting the Percussion of the Wind, so much as it hinder'd the Sails from cutting the Air. (2.) Next we placed Obstacles at some distance behind the Sails, the whole breadth of them all; that the Wind being more compress'd, might strike the stronger: but this rather did harm; as the Repercussion checked the primary Motion. (3.) Lastly, we made the Sails double their former Width, that the Wind might be compress'd the more; and have a stronger lateral Percussion: and this succeeded extremely; so that the Sails turned with a much gentler Blast; and revolved with a far greater Velocity.

Experiments upon altering the Sails of Wind-Mills.

P R E C E P T S.

(1.) Perhaps this increase of Motion may be more commodiously procured by six or eight Sails, than by four of twice the Breadth; unless the Bulk should be too great for the Motion. But of this let Trial be made^t.

A Trial of six or eight Sails recommended.

(2.) The Length of the Sails also contributes to the Motion: for in all Rotations, a small Force applied towards the Circumference, is equal to a much greater towards the Center. But the lengthening of the Sails has this Inconvenience, that the longer they are, the wider they stand from one another a-top; and the less the Wind is compress'd. It might, perhaps, succeed, to have the Sail somewhat long, and widening towards the Top, like an Oar: but this we have not tried.

Oar-Sails to be tried.

A D M O N I T I O N S.

(1.) If these Experiments be reduced to Practice in Wind-Mills, the whole Machine must have Strength in its Structure; especially in its Foundation; with large Sails, to be strong built.

Wind-Mills with large Sails, to be strong built.

^t Which directly tends to over-set the Mill.

^t Enquire the Success of a full Circle of Sails, placed Valve-fashion, for the Wind to slip thro'; as in the Wind-Mill at Deptford-Bridge, near London.

dation : for the more the Wind is compressed, tho it whirls the Sails round the faster ; yet it also gives the greater Shock to the Mill.

Wind-Coaches.

(2.) 'Tis reported, that there are, in certain Places, *Wind-Coaches*, or Caravans, driven with Sails ; which is an Affair that should be well enquired into †.

P R E C E P T.

Carriages to be assisted by the Wind.

Carriages to move by the Wind are impracticable, except in Plains, and open Places. And even here also, what must be done when the Wind fails ? It is more rational to think of easing the Motion of Waggons, and Carriages, by moveable Sails, to take up and down ; which might favour the Horses, and ease their Labour ; than pretend to drive by Land, with the Wind alone.

S E C T. XIV.

Of the Prefages, or Prognosticks of the WINDS ; in prosecution of the fifteenth Article of the Table of Enquiry.

T R A N S I T I O N.

Natural Divination to be cultivated.

THE more *Divination* † has been corrupted with Vanity and Superstition ; the more the purer part of it should be received and regarded. But *Natural Divination* is sometimes more, and sometimes less certain ; according to the Nature of the Subject whereon 'tis exercised : so that in a Subject of a constant and regular Nature, it affords a true Prediction ; but in Things of a various, compounded, and casual Nature, one that is fallacious. And yet, even in a variable Subject, Predictions will generally hold true, if care be used in forming the Rules ; or not err greatly, tho it should not hit upon the precise Time of Events. But even in point of Time, some Predictions will come very near ; particularly such as are derived not from *Causes*, but from the actual *Beginnings* of Things ; tho they manifest themselves sooner, in a prepared and well-disposed Matter, than otherwise. We now, therefore, proceed to the *Prognosticks of Winds* ; wherewith we shall necessarily intermix some others, concerning Rain and fair Weather ; which cannot well be separated from the former : but leave the particular Enquiries about them to their own proper *Titles*, and *Histry*.

I. If

† Accounts and Descriptions of this kind are to be met with in Voyages to the *Eastern Countries* ; but how far they may be safely relied upon, is not certain. And such kind of Contrivances seem chiefly used in sandy Deserts ; the Sand here, in some measure, answering to Water ; so as to make the Motion a kind of Sailing.

‡ See the *Article* DIVINATION, in the *Sylva Sylvarum*.

1. If the Sun appear concave at its rising, the Day will prove windy ; or showry : if the Concavity seem shallow, windy ; but if deep, showry.

2. The Sun rising pale, or, as we vulgarly express it, watery, denotes Rain ; and if it set pale, Wind.

3. If the Body of the Sun set Blood-red, it foretells great Winds, for many Days.

4. If, at Sun-rising, his Rays appear fiery, not yellow ; it denotes Rain rather than Wind. Understand the same of his setting.

5. If, at the rising or setting of the Sun, his Rays appear contracted, or shorten'd, and do not shine out bright ; tho the Weather be not cloudy ; it denotes Rain rather than Wind.

6. If, before Sun-rising, there appear over-early Rays ; it denotes both Wind and Rain.

7. If, at Sun-rising, the Sun throws his Rays from the Clouds, whilst one half of his Body remains clouded ; it fore-shews Rain ; especially if those Rays strike downwards, so as to shew the Sun bearded : but if the Rays break from the middle, or from several Parts, whilst the Sun's external Face remains covered with Clouds ; it signifies great Storms both of Wind and Rain.

8. If the rising Sun be encompassed with a Circle, Wind may be expected from that Quarter where the Circle shall open ; but if the whole Circle shall vanish equably, 'tis a sign of fair Weather.

9. If, towards Sun-set, he appears with a white Circle about him, it promises a little Storm the same Night ; but if the Circle be black, or dusky, it portends a great Wind the next Day.

10. The Clouds looking red at Sun-rising, prognosticate Wind ; but at Sun-setting, fair Weather the Day following.

11. When at Sun-rising Clouds gather themselves near the Sun's Body ; it promises a severe Storm the same Day : but if they fly from the East to the West, it denotes fair Weather.

12. If, at Sun-rising, the Clouds disperse from about the Sun, some to the South and others to the North ; tho the Sky seems clear near the Sun itself ; yet this prognosticates Wind.

13. If the Sun, at setting, be wrapt in a Cloud ; it denotes Rain the next Day : but if it actually rain at Sun-set, it rather denotes Wind ; or, if the Clouds seem to be drawn towards the Sun, it denotes both Wind and Storms.

14. When the Clouds, at Sun-rising, seem not to encompass the Sun, but to hang over him, as if to eclipse him ; this portends Winds to arise from that Quarter where the Clouds incline : but happening at Noon, it denotes both Wind and Rain.

15. When Clouds every way block up the Sun, the less Light there is left and the smaller the Disk of the Sun appears, the more raging will be the Storm : but if the Sun's Body shall appear double, or treble, as if there were two or three Suns, the more severe will the Tempest prove, and continue for many Days.

*Predictions
from the
Moon.*

16. The New-Moon shows the Dispositions of the Air ; tho, principally on the fourth Day, when her Newness seems confirmed : but the Full Moon is a stronger Prognostick than any of the Days that succeed it.

17. By long Observation, the fifth Day of the Moon is held suspected, at Sea, for stormy.

18. If the New-Moon does not appear till the fourth Day, it prognosticates a troubled Air for the whole Month.

19. If the New-Moon, either at her first Appearance, or within a few Days after, has her lower Horn obscure, dusky, or any way sullied ; it denotes foul Weather and Storms, before the Full : but if she be discoloured in the middle, Storms are to be expected about the Full ; or about the Wane, if her upper Horn be affected in like manner.

20. When the Moon, on her fourth Day, appears pure and spotless, her Horns unblunted, and neither lying flat nor standing erect, but betwixt both ; it promises fair Weather, for the greatest part, till New-Moon again.

21. If at this time she rises red, it portends Wind ; if reddish, or dusky, Rain : but it denotes neither beyond the Full.

22. An erect Moon is generally threatening, and unfavourable ; but particularly denotes Winds : tho if she appear with short and blunted Horns, it rather denotes Rain.

23. If one Horn of the Moon shall be more pointed and erect, and the other more obtuse ; it rather denotes Wind : but if both, it denotes Rain.

Halos.

24. A Circle, or Halo, about the Moon, rather denotes Rain, than Wind ; but if she appear erect, within the Circle, it portends both.

25. Circles about the Moon always denote Winds, on that side where they break : and a remarkable Brightness of the Circle, in any part, denotes Winds from that part.

26. Double or treble Circles about the Moon, portend severe and dreadful Tempests ; and much more, if those Circles are not entire, but broken and spotted.

27. The Colours and Halo's attending the Full-Moon, afford nearly the same Presages as the Moon's fourth Day ; but the Accomplishment is more immediate.

Full-Moon.

28. The Full-Moon is generally more attended with fair Weather, than other Ages of the Moon ; but sometimes, in the Winter with intense Cold.

29. The Moon appearing larger about Sun-set, yet luminous and not dusky, promises fair Weather for many Days.

Eclipses.

30. An Eclipse of the Moon is commonly attended with Wind ; an Eclipse of the Sun, with fair Weather ; and seldom either of them with Rain.

*Conjunctions
of the Planets.*

31. Wind is to be expected both before and after the Conjunctions of all the Planets with one another ; but fair Weather after their Conjunctions with the Sun.

*Rising of the
Constellations.*

32. Mild Rains and Showers follow upon the rising of the *Pleiades*, and *Hyades* ; but Storms upon the rising of *Orion*, and *Arcturus* *.

33. Shooting

* See the Note upon § 6. of Sect. X. pag. 472.

33. Shooting Stars, as they are commonly called, foretel Winds to arise *Star-shoots.* soon, from that Quarter whence such supposed Stars darted : but if they fly from several, and contrary parts ; it denotes great Tempests, both of Wind and Rain.

34. When the small Stars are not visible, any where in the Sky ; it pre- *Small Stars in-* sages great Storms and Rains, within a few Days : but if these small Stars *visible.* are obscured in some parts, and clear in others, it foretels only Wind ; but sooner.

35. An equably bright Heaven at the New-Moon, or on her fourth Day, *Obscurity of* presages fair Weather, for several Days ; when uniformly obscure, Showers ; *the Heavens.* but when interruptedly obscure, Winds from that Quarter where the Obscurity is. And if the Heavens grow dark on a sudden, without Cloud or Fog to intercept the brightness of the Stars ; 'tis a Sign that rough and severe Storms are at hand.

36. When an entire Circle surrounds a Planet, or any large fixed Star, *Circles about* it presages Rain ; but if the Circle be broke, Winds, from that Quarter *the Stars.* where the Breach is.

37. When it thunders more than lightens, expect great Winds : but if *Thunder.* it lightens frequently between the Thunder-Claps, expect hasty Showers, with large Drops.

38. Thunder in the Morning foreshews Wind : and in the Afternoon, Showers.

39. Loud Thunder, if it roll and pass by the Place where 'tis heard, denotes Winds ; but that consisting of unequal and sharp Claps, denotes Storms, both of Wind and Rain.

40. If it lightens, and the Sky be clear, Winds and Rain are soon to be expected, from the Quarter where the Lightning happens ; but if it lightens from different parts of the Sky, severe and dreadful Tempests are to follow.

41. When it lightens from the cold Quarters of the Heavens, as the *Lightning* North and North-East ; Hail usually follows : but if from the warmer, as *from different* the South and West, sultry Showers. *Points.*

42. Great Heats, after the Summer's Solstice, generally end in Thunder *Great Heats.* and Lightning ; or, if these succeed not, terminate in Wind and Rain, that last for many Days.

43. The fiery Ball which is seen at Sea, and called *Castor* by the Ancients, *From the Bro-* if it be single, prognosticates a severe Tempest ; and so much the more, *thers at Sea.* if it does not adhere to the Mast of the Ship, but rolls or dances about : but if there appear two of them, or both *Castor* and *Pollux*, together, when the Storm is grown strong, this is reckoned a good Sign ; but if there be three of them, or *Helena* also attending, the Tempest becomes more outrageous : so that the Appearance of one alone, denotes Crudity in the tempestuous Matter ; two a Concoction or Ripeness thereof ; but three or more, such a large Collection as is dissipated with difficulty.

44. If the Clouds drive fast whilst the Sky is clear, let Winds be ex- *From the* pected from that Quarter whereto the Clouds are driven ; but if they collect *Clouds.* and roll up together, they will afterwards begin to separate and disperse,

The HISTORY of the WIND.

when the Sun approaches to that Part where they are collected: and if they disperse more towards the North, it denotes Wind; but if to the South, Rain.

45. The Clouds rising black or dusky at the setting of the Sun, denotes Rain the same Night, if they rise opposite to the Sun, or in the East; but the next Day, attended with Wind, if they rise near the Sun, or from the West.

46. The Sky clearing up, or the Clouds breaking away into a Part opposite to the Wind that blows, denotes fair Weather; but clearing up towards the Wind, it yields no certain Prognostick.

47. Sometimes there are several Floors, or Stories of Clouds, one above another; five whereof Dr. Gilbert declares, he has sometimes observed at once: but the lower are always blackest; tho it may sometimes appear otherwise; because the whiter strike the Sight most. A double Range of them, if thick, denotes approaching Rain; especially if the lower Cloud seem swollen: and more Floorings denote the continuance of Rain from Day to Day.

48. When the Clouds appear fleecy, and are dispersed up and down the Sky, they denote Storms; but if they appear to wrap over one another, like Scales, or the Tiling of a House, they promise dry and fair Weather.

49. Feathered Clouds, or such as appear like the Branches of the *Palm-Tree*, or the *Flower-de-luce*; denote Showers at hand, or not far off.

50. When Hills and Mountains appear, as it were, with their Caps on, from the Clouds that hang about and surround them; 'tis a Sign of impending Storms.

51. Clouds appearing of an Amber or Gold Colour, before Sun-set; and having, as it were, their Edges gilt with Gold; promise fair Weather, after the Sun is gone down lower.

52. Clouds that appear muddy and dirty, prognosticate Rain and Wind at hand.

53. The sudden Appearance of a light Cloud, in a clear Sky; especially coming from the West, or about the South; denotes a Storm a-brewing.

54. The Appearance of a white pregnant Cloud, called by the Ancients a *white Tempest*; denotes small Hail in the Summer, and Snow in the Winter.

From Mists.

55. When Mists and Fogs rise upwards, they denote Rain; if they mount suddenly, as if they were sucked up, they foreshew Winds; but when they fall, and remain in the Vallies, fair Weather.

56. A serene Autumn denotes a windy Winter; a windy Winter, a rainy Spring; a rainy Spring, a serene Summer; a serene Summer, a windy Autumn: So that the Air, upon a Balance, is seldom Debtor to itself. Nor do the Seasons succeed each other, in the same Tenor, for two Years together.

*The burning of
Fire and
Candles.*

57. When our common Fires burn paler than usual, and murmur or resound within, 'tis a Sign of a Storm; if the Flame, curls, bends, and waves in its rising, it principally denotes Wind; but spongy Excrescences in the Snuffs of Candles and Lamps, rather denote Rain.

58. When Coals burn bright and shining, 'tis a Sign of Wind ; so, likewise, when they quickly deposite and throw off their Ashes.
59. When the Sea appears calm on its Surface from the Land, and yet *From the Sea.* has a murmuring Noise, tho without swelling ; this foretels Wind.
60. The founding of the Shores in a Calm, and the ringing of the Sea itself, with a certain Flutter, or kind of Echo, heard more distinctly, and to a greater distance than usual, prognosticates Winds.
61. The Appearance of Froth, white Crowns, or Bubbles of Water up and down, on the Surface of the Sea, whilst it lies flat and calm, denotes Winds ; and when these Signs are more remarkable, severe Tempests.
62. The Appearance of a shining Froth, called Sea-Lungs, upon a rough and turbulent Sea, denotes a Continuance of the Tempest for many Days.
63. When the Sea swells without Noise, and rises to the Shore higher *Tide.* than usual ; or if the Tide comes in fresher than ordinary ; this prognosticates Winds.
64. A Sound coming from high Hills, and a murmuring Noise rising in *From Hills* Woods, as also a kind of Crackling in open Places, foretels Winds : so *and Woods.* likewise an unusual Murmuring in the Heavens, without Thunder, principally denotes Winds.
65. Leaves and Chaff playing in the Air, without any sensible Breeze ; *Light Matters* the Downe of Plants flying about ; and Feathers floating and playing upon *playing.* the Waters ; denote Winds at hand.
66. Water-Fowl flying and flocking together ; but particularly Mews, *Water-Fowl,* Gulls, and Moor-Hens, quitting the Sea or Rivers, and hastening to the Shores or Banks, especially if with a Cry ; and again, their playing on the dry Land, foretels Winds ; especially if this happen in the Morning.
67. On the contrary ; when Land-Fowl go to the Water, strike it with *Land-Fowl,* their Wings, wash themselves, and raise their Cry ; but especially the Crow ; this portends Tempests.
68. Ducks and Coots, or Didappers, are observed to prune their Feathers *Ducks, Geese,* before Wind ; but Geese with their importunate Gaggles, seem to call down *&c.* Rain.
69. When the Heron tours upright, so as sometimes to fly above a low *The Heron and* Cloud ; this denotes Wind : but the high Flight of a Kite denotes fair *Kite.* Weather.
70. The continued Croaking of the Raven, in a sobbing manner, presages *Raven.* Wind ; but if it be by Fits, in a stifled manner ; or if the Croak be repeated at longer Intervals, it denotes Rain.
71. The Whooping of the Owl was thought, by the Antients, to denote *Owl.* a change of Weather, from fair to Rain, or from cloudy to fair : but with us, if the Owl whoops free and clear, it generally denotes fair Weather ; especially in Winter.
72. If the Birds which roost on Trees fly early to their Nest, and quit *Birds flying* their Feeding soon, it presages Storms ; but when the Heron stands melan- *early to their* choly upon the Sand, or the Raven stalks about, it denotes only Rain. *Nests.*

Dolphins.

73. When Dolphins play in a Calm at Sea, this is thought to foretel Wind from that Quarter whence the Dolphins come ; on the contrary, their playing, and throwing the Water about, in a rough Sea, denotes fair Weather : but for most other Kinds of Fish ; their swimming a-top, and sometimes leaping out of the Water, denotes Rain.

Hogs.

74. Hogs are so disturbed, affrighted, and strangely affected at the rising of Wind, that the Country People have a Notion, this is the only Creature that can see the Wind ; and imagine it a frightful Sight.

Spiders.

75. Spiders ply their Work hard before Wind ; as if they snatched the Opportunity of spinning their Webs, before the Wind should come to prevent them.

Sounds.

76. The ringing of Bells is heard to a greater distance before Rain ; but before Wind more unequally : the Sound coming and going, as it does when the Wind blows strong.

Trefoil.

77. *Pliny* delivers it as certain, that Trefoil bristles and pricks up its Leaves against a Storm.

Meats sweating.

78. He likewise adds, that Vessels containing Eatables, will sometimes leave a Sweat behind them in the Buttery where they stood ; and that this prognosticates severe Tempests.

ADMONITION.

The History of Rain to be consulted.

Since Rain and Winds have nearly the same common Matter ; and since some Condensation of the Air always precedes Wind ; because the new-made Air is received within the old ; as appears by the ringing of the Shores, &c. the high flight of the Heron, &c. and since, in like manner, a Condensation of the Air always precedes Rain ; it follows, that Rain must have many Prognosticks in common with Wind ; for which, the Prognosticks of Rain, should be consulted under *the particular History of that Meteor* *.

SECT. XV.

Of Imitating the WINDS ; in regard to the sixteenth Article of the Table of Enquiry.

TRANSITION.

Mens manner of enquiring too confined.

IF Men could but persuade themselves, not to pin their Minds down to the sole Consideration of the Subject they propose ; so as to forget every thing else, as little to the Purpose ; which they subtilize and speculate for ever upon it, as they generally do, in a fruitless manner ; they could not be so stupefied

* But this *History* is not hitherto extant, that we know of. If proper Histories of all the Meteors were wrote, tho it were in no greater Perfection than the present *History of Winds*, they might afford much Light to one another.

stupefied as they commonly appear; but would transfer their Thoughts, and, by reasoning, discover many Things at a distance, which lay hid nearer hand. It were, therefore, proper to transfer the Method and Conduct observed in the *Law*, to the *Law of Nature*; and proceed in natural Enquiries with the same Sagacity and Reasoning, from Parallels and Similitudes, as we practice in Law-Cases ¹.

1. Bellows, with Men, are the Store-Vessels of Wind; from whence we derive it, in Proportion to our Wants and Abilities. The Vallies and Interstices of Mountains, and the open Windings and Turnings betwixt Buildings, are but larger kinds of Bellows. The principal Uses of Bellows, are the animating of Fire; and blowing the Organ. They act by drawing in the Air, to prevent a *Vacuum*, as the Phrase is; and driving it out again by Compression. *The Use and Action of Bellows.*

2. We likewise use Hand-Fans for Coolness, and the making a Wind. These impel the Air but gently ². *Fans.*

3. We have already mentioned a Method of making Rooms cool in Summer³; but more curious and exact Ways may be discovered, especially if, in the manner of Bellows, the Air was drawn in at one part, and discharged at another. But the Methods at present in use for this Purpose, turn only upon Compression. *Cool Rooms.*

4. There is a great Agreement between the Winds of the World, and the Flatulencies in the Body of Man, and other Animals: for these also are generated from Moisture, and alter with it; as Winds and Rains do. They are also dissipated, and made to perspire, by a stronger Heat. And hence an Observation may be transferred to the Winds; viz. their being produced from a Matter affording a tenacious Vapour, that is not easily dissipated; as we find by Beans, Pulse and Fruit; which proves the Case also in the greater Winds. *Agreement between Winds and Flatulencies in the Body.*

5. In the Distillation of Vitriol, and other Fossils, which are flatulent and explosive, they are obliged to use large Receivers, to prevent their being broke ⁴. *Wind generated in Distillations.*

6. The Wind made by the Nitre in Gunpowder, bursting out of a sudden, and blowing the Flame along, not only equals, but exceeds all other Winds; excepting those of Thunder. *By Gunpowder.*

7. The

¹ Let the present History serve for an Example; wherein all Nature and Art seems to have been searched, with a View to the Subject; and Matters brought in for it from every Quarter. When all the Materials belonging to the Subject are thus found, collected, and ranged in their properest Order, so as to afford a perfect Set of Tables, with their *Axioms*; and fully exhibit the Thing as it is in Nature; then will the Enquiry be finished, and not before. See the *Novum Organum*. Part II.

² Add here the common Method of Winnowing by the Wheel-Fan; shooting with the Wind-Gun, &c.

³ See Sect. VIII. *Accidental Generations of Winds.*

⁴ Here enumerate the Bodies that generate most Air by Distillation; viz. Tartar, Tallow, &c. See Mr. Hales's *Vegetable Statics*.

The HISTORY of the WIND.

7. The Force of the Wind is compressed in Machines, and Engines of human Invention ; as in Guns, Mines, and Powder-Houses, when they fire and blow up ; but it has not hitherto been experienced, whether if a large Quantity of Gun-powder were fired in the open Air 'twould raise a Wind, by the Commotion of the Air, that should last several Hours ^c.

*By Mercury
and Gold.*

8. There is a flatulent and expansive Spirit concealed in Quicksilver ; so as to make it, in effect, resemble Gunpowder : and a little of it mixed along with Gunpowder, makes the Powder stronger. The Chémists also speak of Gold, as if in some ways of preparing, it would make an Explosion, almost like Thunder ^d.

A larger OBSERVATION.

*The Motion of
the Winds seen
by that of the
Water.*

The Motion of the Winds is, in many Respects, seen, as in a Glass, by the Motion of the Waters. (1.) Great Winds are Inundations of the Air, like Inundations of the Water ; both proceeding from an Increase of Quantity. (2.) As Waters either descend from above, or flow from the Earth ; so some Winds are thrown down from on high, and some rise up from below. (3.) As sometimes in Rivers there are contrary Motions, one Motion of the Tide, another of the River's Course ; and yet but a single Motion takes place ; that of the Tide becoming predominant : so, likewise, when contrary Winds blow, the greater subdues the less. (4.) As it sometimes happens in Currents of the Sea, and certain Rivers, that the Water a-top moves in a contrary Direction to that below ; so, likewise, in the Air, when contrary Winds blow, together, the one flies over the other. (5.) As there are Cataracts of Rain falling within a narrow compass ; so there are, in like manner, narrow Eddies of Wind, or Whirlwinds. (6.) As Waters, when disturbed, will have an Undulation, besides their progressive Motion ; so likewise have the Winds. And besides these, there are other Correspondences between them, derivable from the present Enquiry.

S E C T. XVI.

Imperfect AXIOMS ; or Variable CANONS, *formed upon the preceding Enquiry.*

T R A N S I T I O N.

CANONS, or AXIOMS, are either *particular* or *general* ; but both of them with us are variable or improvable : for we dare not yet pronounce upon any thing. As to *particular Axioms*, they may be deduced and collected

^c As the firing of great Guns is said to allay Storms,

^d This seems meant of the *Aurum Fulminans*.

collected from almost every *Article* ; but we shall here subjoin a few of the general ones, that we have ourselves drawn out^e.

A X I O M I.

1. *Wind is nothing more than Air put into Motion, either by a simple Impulse, or the Admixture of Vapours.* *The Nature of Wind.*

A X I O M II.

2. *Winds are produced by the simple Impulse of the Air, four Ways ; viz.* *Winds produced by four Impulses.*
(1.) *By the natural Motion of the Air ;* (2.) *by the Expansion of the Air in the Path of the Sun ;* (3.) *the Contraction of the Air by sudden Cold ; and,*
(4.) *by the Compression of the Air from external Bodies.*

There may possibly be a *fifth Way* ; viz. by the Agitation and Concussion of the Air from the Stars : but Operations of this kind should not be mentioned yet^f ; or else should be but sparingly received.

A X I O M III.

3. *The principal Cause of Winds, produced by the Admixture of Vapours, is, the Air's being over-loaded by the Air newly formed from Vapours ; whence the Bulk of the Air increases, and requires more room.* *The principal Cause of vaporous Winds.*

A X I O M IV.

4. *A small, fresh Supply of Air may cause a great Swell, every way, in the Atmosphere ; so that this new Air, from the Resolution of Vapours, contributes more to the Motion than the Matter : but the great Body of the Wind consists of the former Air. And the new Air does not drive the old Air before it, as if they were separate Bodies ; but both being mixed together, they require a larger Space.* *A small Supply of Air, may prove a great Cause of Wind.*

A X I O M V.

5. *When there is another Principle of Motion besides the Surcharge of the Violent Wind, Air ; this proves an Accessory, that increases and strengthens the Principal : seldom proceed whence it is, that great and boisterous Winds seldom arise from a bare Surcharge of the Air.* *from a bare Surcharge of Air.*

A X I O M VI.

6. *There are four Accessories to the Surcharge of the Air ; viz. (1.) Subterranean Expirations ; (2.) Precipitation from that called the Middle Region of the Air.* *Four Accessories to the Surcharge of the Air.*

^e See *Novum Organum*, Part II. Aph. V.

^f Till better known and discovered ; or till Natural Philosophy itself is farther advanced.

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the Air ; (3.) Diffipation of formed Clouds ; and, (4.) Mobility and Acrimony of the Exhalation itself.

A X I O M VII.

The Motion of the Wind generally lateral.

7. *The Motion of the Wind is almost constantly lateral : that which proceeds from the simple Surcharge of the Air, is so from the first ; and that which proceeds from subterraneous Expirations, or Repercussion from above, becomes so soon after ; unless when the Eruption, Precipitation, or Reverberation, are exceedingly violent.*

A X I O M VIII.

Winds denser than Air.

8. *Air will sustain some Compressure before it becomes sensible of being overloaded, or before it will impel the Air contiguous to it ; whence it is, that all Winds are somewhat more dense than Air at rest.*

A X I O M IX.

Winds laid five Ways.

9. *Winds are allay'd five Ways ; viz. (1.) When the Vapours come together ; (2.) incorporate ; (3.) sublime ; (4.) transport ; or, (5.) spend themselves.*

A X I O M X.

Rain formed four Ways.

10. *Vapours come together, or the Atmosphere forms itself into Rain, four Ways ; viz. (1.) By being oppress'd with Quantity ; (2.) condensed by Cold ; (3.) by contrary Winds driving the Vapours together ; and, (4.) by reverberating Obstacles.*

A X I O M XI.

Vapours and Exhalations the Matter of Winds.

11. *Both Vapours and Exhalations afford Matter of Winds : for the Rain never proceeds from Exhalations ; yet Winds may frequently proceed from Vapours. But there is this Difference, that the Winds made from Vapours more easily incorporate with pure Air, become sooner appeas'd, and prove not so stubborn, as those from Exhalations.*

A X I O M XII.

Heat has a Power to produce Wind.

12. *The Modification and different States of Heat, have as great an Effect in the Production of Winds, as the Quantity or Conditions of the Matter.*

A X I O M XIII.

The degree of Heat required to produce Winds.

13. *In the Generation of Winds, the Sun's Heat should be so proportionate as to excite them ; but not so plentifully as to make them collect into Rain ; nor yet so sparingly as to make them totally disperse and dissipate.*

A X I O M

A X I O M XIV.

14. Winds blow from the Quarters of their Nurseries: and when these Nurseries are differently seated, different Winds generally blow together; but the stronger either subdues the weaker, or turns it into its own Current.

The manner wherein Winds blow.

A X I O M XV.

15. Winds are generated all the way up, from the Surface of the Earth to the cold Region of the Air: but those that blow ofteneſt, are generated near the hand; and the stronger above.

Winds generated thro' the whole height of the Atmosphere.

A X I O M XVI.

16. The Countries which have their Serving-Winds warm, are hotter; and those that have them cool, are colder; than in proportion to the Climate.

Serving Winds cool or warm, according to the Country.

S E C T. XVII.

A Table of Particulars more immediately serviceable to Mankind: or DESIDERATA with their APPROXIMATIONS; drawn from the preceding Enquiry.

D E S I D E R A T U M I.

A Method of forming and disposing the Sails of Ships, so as with a less Wind to make more way: a Thing of great Use for shortning Voyages, and lessning their Expence.

More advantageous Sails and Wind-Mills.

A P P R O X I M A T I O N.

No Discovery has hitherto been made to answer this *Desideratum* precisely in practice; but consult the larger *Observations* under *Section XIII.*

D E S I D E R A T U M II.

To construct Wind-Mills, and their Sails, so as that they may perform more Work with less Wind: which also is a Matter of Advantage.

A P P R O X I M A T I O N.

Consult upon this Head our Experiments under *Section XIII.*

DESIDERATUM III.

To predict the Winds. A Method of predicting the Rising, Falling, and Times of the Winds: a Thing of use in Navigation, and Agriculture; but especially in chusing the Times for Sea-Fights.

APPROXIMATION.

There are many Things to this Purpose in the preceding Enquiry, especially under Section XIV. But the Observations of Posterity, now the Cause of Winds is explained, may afford much more exact Prognosticks.

DESIDERATUM IV.

To predict Discoveries of new Countries. A Method of prognosticating, and forming Judgment, upon other Things, from the Winds: for Example, whether there be any other unknown Continents, or Islands in the Sea of any Place; or whether the Sea be open and uninterrupted: a Thing of Use in Navigation; and the Discovery of new Countries.

APPROXIMATION.

The Approximation here, is the Observation of Stated Winds; which seems to have been used by Columbus.

DESIDERATUM V.

To predict Plenty and Scarcity. A Method of predicting the Plenty or Scarcity of Fruits, and Corn, every Year: which would be Matter of Profit, and regulate Bargains and Sales for Time; as Thales, from a natural Divination of this kind, is said to have bought up all the Olives of his Country.

APPROXIMATION.

There are some Things to this Purpose under Section VI.

DESIDERATUM VI.

To predict Sickness, &c. So likewise it would be an useful Thing, and for the Reputation of Physicians, to predict the Diseases and Pestilences of each Year; if this could be done: as also, for discovering the Causes and Cures of Distempers; with some other Affairs of political Consideration*.

APPROXI-

* See the Author's *New Atlantis ad finem.*

APPROXIMATION.

And with regard to this, also, there are certain Particulars in the present Enquiry, especially under *Section VI.*

ADMONITION.

In the Business of predicting Plenty or Scarcity of Corn and Fruits, and the Rise of Distempers by the Winds; let the Histories of *Agriculture* and *Medicine* be consulted¹.

The History of Agriculture and Medicine to be consulted.

DESIDERATUM VII.

A Method of raising and laying the Winds.

To raise and allay the Winds.

APPROXIMATION.

There are certain superstitious and magical Relations, with regard to this Matter, not worthy to be received into a serious and rigid *Natural History*; nor can we, at present, think of an *Approximation*. However, with a View thereto, let the Nature of the Air be thoroughly sifted and examined; to try whether any thing may be found, that when communicated in a small Quantity to it, may excite and multiply Motion; so as to dilate and contract the Body of the Air: for if this could be done, the raising and laying of the Winds would follow of course; after the manner of *Pliny's* Experiment, if true, of playing Vinegar into a Whirlwind. Another Attempt might be made, by letting out the Winds from subterranean Places; if any were plentifully collected therein; as is currently reported of the Pit in *Dalmatia*: but it will be difficult to discover the Places wherein Winds are thus imprisoned.

DESIDERATUM VIII.

Ways of producing many surprizing and diverting Phænomena, by the Motion of the Winds.

To produce strange Appearances by Wind.

APPROXIMATION.

But of the Methods for affecting this, we have no leisure to consider. The *Approximation* is the common Way of fighting Battles by

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the

¹ See above, the *Admonition* at the close of *Señ. XIV.*

The HISTORY of the WIND.

the Wind^m. And, doubtless, many agreeable Things of this kind might be invented ; both with regard to Motion and Soundⁿ.

^m This is also mentioned under the thirteenth Article of the *Table of Enquiry*. I suppose the Author means the School-Boys Diverſion of fighting Battles, by the flying of Paper-Kites.

ⁿ See the *Sylva Sylvarum*, under the Article SOUND. In order to prosecute the Enquiry, it might be proper to consult, all that relates to it in the *Philosophical Transactions*; *French Memoirs*; and *German Ephemerides*; Sir Isaac Newton's *Principia*; Mr. Boyle's *Philosophical Works*; Stahl's *Observatio Meteorologia Cokio-Sluteriana*; Boerhaave's four Chapters upon the Elements, in his *Chemistry*; *Honoratus Faber*. &c. But some of the principal Matters here required, seem not hitherto received into Books; and must be derived immediately from *Nature*, the common *Practical Arts* or new *Experiments*, purposely made to give farther Light, and Information, in this Subject.

End of the History of WINDS.

A
P L A N
For the PARTICULAR
H I S T O R Y
O F
Condensation and Rarification,
I N
N A T U R A L B O D I E S.

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P R E F A C E.

THIS is a posthumous Piece, and published in the original Latin, with considerable Care, by the Author's Chaplain and Amanuensis, Dr. Rawley; that being a very imperfect Edition given of it by Gruter. It is one of the Six Histories which the Author designed to write monthly. Three of these monthly Productions are extant; viz. The History of Life and Death; Winds; and the present History of Rarity and Density. But those of Sympathy and Antipathy; the Three Chemical Principles; and of Gravity and Levity; were not published. Nor does there appear to be any thing hitherto written that may supply the Want of them. But the Original, from whence they were to be copied, is Nature; which we have always before us.

The Subject of Rarification and Condensation, has indeed been laudably prosecuted by the Moderns; especially since the Invention of the Air-Pump, and other pneumatical and hydrostatical Engines and Instruments. Yet it does not seem to have been pursued in all that Variety and Fullness, wherein it is here sketched out by the Author.

An unseasonable Indulgence of mathematical Speculations, seems to have somewhat diverted the Pursuit: for the Thing appears of late, to have been rather mathematically than physically considered. So that we have had Worlds made in the Imagination, by the supposed Rarification of single Particles of Matter; and many other such mathematical Leavities, or Sports of Fancy; whilst the full Process and Use of Rarification, and Condensation, in the real World, has been less attended to than it deserves. For, doubtless, a thorough Knowledge of this Subject would lead to a Discovery of many Arts and Works; an Instance whereof we have lately had in
the

P R E F A C E.

the Discovery of that noble Engine, for Raising Water by Rarification, and Condensation.

It may, perhaps, appear surprizing, to those who shall diligently peruse the following Piece, that the Author should have seen so far into the modern Physicks; and himself have here laid, not only the Foundations of our present Hydrostaticks, and Pneumaticks, but also of much greater Discoveries.

I N T R O.

INTRODUCTION.

NO wonder if Nature remain Debtor to Philosophy and the Sciences, when she has never yet been summoned to an Account. For there has hitherto been no careful and regular Enquiry, no exact or tolerable Estimate made, as to the Sum or Quantity of Matter in Nature; nor any Notice taken how it is disposed, and laid out upon Bodies. 'Tis a just *Axiom*, *That nothing can be detracted from, or added to the Sum total of the Universe*. And some, indeed, have handled the *Common-place*, how Bodies may be relaxed and contracted, in respect of more and less, without admitting a *Vacuum* between: but for the Nature of *Condensation* and *Rarification*, one attributes it to a greater and less Quantity of Matter; another eludes the Point; whilst the Generality, following their Author^a, think to discuss and settle the whole Matter by that trifling Distinction of *Act* and *Power*. And even they who attribute *Condensation* and *Rarification* to the different Quantities of Matter, which is the true Notion, and do not totally deprive the *Materia prima* of Quantity; tho, for other Forms, they require it to be indifferent, yet here end their Enquiry, and look no farther; without perceiving the Consequence: thus slightly passing over, or at best not fully pursuing, a Consideration which regards infinite Particulars; and is, in a manner, the Foundation of all *Natural Philosophy*.

To proceed, therefore, upon what has been justly laid down in all the Transmutations of Bodies; Matter can never be annihilated; but it requires the same omnipotent Power to annihilate, as to create out of Nothing; neither of which ever happens in the Course of Nature; so that the original Quantity of Matter remains for ever the same, without Addition or Diminution. And that this original Stock of Matter is differently portioned out among Bodies, cannot be doubted; for it were Madness, by abstract Subtilties, to pretend, that one Hogshead contains as much Water as ten Hogsheads of Water; or, that one Hogshead of Air contains as much as ten Hogsheads of Air. But tho it be admitted, that the Quantity of Matter rises in proportion to Measure, in the same Body; this is still questioned in Bodies of different Kinds. But if it be demonstrated, that one Hogshead of Water turned into Air, will make ten Hogsheads of

VOL. III.

• f t t

Air

^a Viz. Aristotle.

Air (and it may rather be proved to make a hundred) there is an end of the Dispute ; for, in this case, the Water and the Air are the same Body ; now contained in ten Hogsheads, tho before it was contained in one. And therefore to assert, that one whole Hogshead of Water may be converted into but one whole Hogshead of Air, is, in effect, to assert that Something may be reduced to nothing : for, in this case, one tenth Part of the Water is sufficient ; and the other nine Parts must then be annihilated. So, on the contrary, to assert that a Hogshead of Air is convertible into a Hogshead of Water ; is to assert, that Something may be created out of Nothing : for the Hogshead of Air will make but the tenth Part of a Hogshead of Water ; and therefore the other nine Parts must be produced from nothing.

We shall, however, ingenuously confess it a difficult Task, to settle and ascertain the exact Proportions and Quantities of Matter, contained in different Bodies ; and to shew, by what Industry and Sagacity a true Information may be had thereof : tho the great and extensive Usefulness of the Enquiry may abundantly reward the Pains that shall be bestowed upon it. For to understand the Density, and the Rarity of Bodies, and much more, how to procure and effect their Condensation and Rarification ; is a Thing of the utmost Importance, both in speculative, and practical Philosophy. Therefore, as the Enquiry is, perhaps, of all others, the most fundamental and universal ; we should come to it well prepared : for all *Natural Philosophy* is a perfectly loose and untwisted Thing without it ^b.

^b The Author keeps to his original Design of enquiring into such Subjects first, as are either most useful in themselves, or most fundamental, and leading to others. See Page 8—16. of the present Volume.

A
P L A N
For the PARTICULAR
H I S T O R Y
O F
Condensation and Rarification, &c.

S E C T. I.

A TABLE of Enquiry for the particular History of
DENSITY and RARITY in Natural Bodies.

A R T I C L E I.

Tables of Rarification and Condensation.

D I R E C T I O N.

1. **L** E T a *Table* be formed, from particular Experiments, to shew by Inspection, the specifick Gravities, or different Weights of all tangible Bodies, under equal Dimensions; with relation to *Gold*: and explain the Construction, Nature, and Uses of this Table.

2. Let *Tables* also be formed of Bodies, under the same Dimensions, whole, and in powder; crude and distilled; as also of *pneumatical Bodies*, according to their Degrees of Expansion. The whole of this to regard the Expansion of Matter in Bodies; according to their different Consistencies, whilst at rest.

The History of CONDENSATION,

ARTICLE II.

The Dilatations caused by simple Introsusception ; or the Admission of one Body into the Pores of another.

DIRECTION.

3. If possible, let the Enquiry be here diligently prosecuted about the Appetites and Motions of Bodies, whereby they swell and sink, rarify and condense, dilate and contract, &c. because this is of great Use ; as, at once, serving to disclose, and govern Nature. And yet it must proceed summarily ; because the Subject of *Density* and *Rarity* is so copious and general, that, if fully prosecuted, it would anticipate many of the following *Titles* ; which should not be allowed of.

ARTICLE III.

Dilatation of the innate Spirit, expanding itself.

DIRECTION.

4. Let the Enquiry pass on to the Dilatations and Tumeactions of Bodies ; caused by their own internal Spirit ; whether naturally, or preternaturally ; but without Fire, or manifest external Heat.

ARTICLE IV.

The Dilatations and Relaxations of Bodies, by means of actual, simple, external Heat.

DIRECTION.

5. This Enquiry properly belongs to the Subjects of Heat and Cold, Dilatation, Separation, and Alteration ; yet some Knowledge of the Relaxations of Bodies by Fire is here necessary, for the more commodious carrying on of the Enquiry into Condensation and Rarification. Let this therefore, be touched only as in Passage.

ARTICLE V.

Dilatations by external Heat in Distillations.

DIRECTION.

6. The Enquiry should next proceed to the Dilatations and Relaxations of Bodies by Heat in Distillations ; which affords a better Opportunity, than Cognition or Calcination, of discovering the exact Process of this kind of Relaxation : but as the Prosecution hereof properly belongs to the *Title* of Heat and Cold, and the Motion of Dilatation and Separation ; it should

should be sparingly touched under the present *Article*, tho it were otherwise useful to dwell thereon.

ARTICLE VI.

The Dilatations and Relaxations of Bodies by the Remission of Cold.

DIRECTION.

7. Let the Enquiry next proceed to the Dilatations and Relaxations of Bodies, upon the remission of violent Cold ; or a less comparative degree of Heat ; as in Thawing, &c.

ARTICLE VII.

The Dilatation and Relaxation of Bodies by potential Heat ; or the auxiliary Spirits of other Bodies.

DIRECTION.

8. From the Dilatations made by external Heat, and the remission of Cold ; proceed to those made by potential Heat ; or the assisting Spirits of another Body applied. And as for the Business of *potential Heat*, it is proper to consult the *medicinal Tables* of secondary Qualities ; from thence to collect the Things that separate by Dilatation in the human Body.

ARTICLE VIII.

The Dilatation of Bodies by a Releasement of their Spirit.

DIRECTION.

9. Next proceed to the Dilatation of Bodies made by a Releasement of their Spirits ; upon breaking the Prisons of the grosser Parts, which closely detained them ; so that they could not dilate themselves.

ARTICLE IX.

The Dilatation happening upon the meeting and uniting of Bodies related.

DIRECTION.

10. This kind of Dilatation is, in some cases, called *Diffolution* ; tho it happens without any manifest Tumult. Enquire out the Instances hereof.

ARTICLE X.

The Dilatation by Assimilation ; or the Conversion of a grosser Matter to such as is more subtile.

The History of CONDENSATION,

DIRECTION.

11. This is understood of an actual Conversion of one Body into the Substance of another : the more eminent Instances whereof are to be carefully collected.

ARTICLE XI.

Dilatations or Distractions, by external Force.

DIRECTION.

12. These Dilatations or Distractions, are such as proceed not from any Appetite in the dilated Body ; but from the Violence of a Body external ; which prevailing, obliges the other to dilate.

ARTICLE XII.

Dilatations by Diffusion ; or Spreading.

DIRECTION.

13. This being a spurious kind of Dilatation it need not be here very particularly enquired into : Tho the more eminent Instances should be enumerated ; as the Ductility of Gold, &c.

ARTICLE XIII.

Contractions by the emission, or discharge, of a Body received.

DIRECTION.

14. Having thus prosecuted the Business of *Dilatations, Rarifications, and Relaxations* of Bodies ; the contrary Actions thereto must also be enquired into ; viz. the *Contractions, Condensations, and Shuttings up* of Bodies. And as *Contraction* is correlative to *Dilatation* ; that must be thoroughly examined.

ARTICLE XIV.

Contractions by the shrinking of the grosser Parts, after the discharge of the Spirits.

DIRECTION.

15. Here again, the Instances are to be carefully collected.

ARTI-

ARTICLE XV.

The Contraction of Bodies by actual, external Cold.

DIRECTION.

16. This is the reciprocal Action to that of Dilatation by external Heat; and the most genuine and proper kind of Contraction. Here, therefore, the Enquiry should be more largely and fully prosecuted; so far as the degrees of Cold, upon the Earth's Surface, can be made to reach.

ARTICLE XVI.

The Contraction of Bodies by potential Cold.

DIRECTION.

17. Let this Article be prosecuted as the correlative to *Article VII.*

ARTICLE XVII.

The Contractions of Bodies by Flight, and Antiperistasis.

DIRECTION.

18. This is the opposite to *Dilatation by Union and Embrace.* See *Article IX.*

ARTICLE XVIII.

The Contraction of Bodies by Assimilation or Conversion, into a denser State.

DIRECTION.

19. This is the correlative to *Article X.*

ARTICLE XIX.

The Contractions of Bodies by external Violence.

DIRECTION.

20. This corresponds to *Article XI.*^c

SECT.

^c Fuller Directions, Admonitions, and Precepts, are occasionally interspersed in the Enquiry itself.

S E C T. II.

A TABLE expressing the DENSITY and RARITY, or Specifick Gravities, of different tangible Bodies, in proportion to Gold; with the Explanation, and Uses thereof.

The Bodies in the following Tables were all taken of the same Bulk, or Dimensions.

The TABLE, in alphabetical Order. ^d

Pure GOLD weigh'd an Ounce, or twenty Penny-Weight.

	Penny-Weight.	Grains.		Penny-Weight.	Grains.
<i>Alabaster</i>	2	12	<i>China-root</i>	1	2
<i>Alum</i>	1	21	<i>Clay, common</i>	2	8 $\frac{1}{2}$
<i>Amber</i>	1	3	<i>— Tobacco-pipe</i>	2	5 $\frac{1}{2}$
<i>Aqua fortis</i>	1	7	<i>Copper</i>	9	8
<i>Asbes, common</i>	1	0 $\frac{1}{2}$	<i>Crystal</i>	2	18
<i>Balsam, Indian</i>	1	6	<i>Earth, common</i>	2	1 $\frac{1}{2}$
<i>Beer, strong</i>	1	3 $\frac{1}{2}$	<i>Ebony-wood</i>	1	3 $\frac{1}{2}$
<i>Benjamin</i>	1	0	<i>Fennel-seed, powder'd</i>	1	3 $\frac{1}{2}$
<i>Borage, its exprefs'd</i>	} 1	3 $\frac{1}{2}$	<i>Fir-wood</i>	0	15
<i>Juice</i>			<i>Flint</i>	2	22 $\frac{1}{2}$
<i>Brass, coarse</i>	8	9	<i>Glass</i>	2	20 $\frac{1}{2}$
<i>— fine</i>	9	5	<i>Guaiacum-wood</i>	1	10
<i>Brimstone</i>	2	2	<i>Jet</i>	1	5
<i>Butter</i>	1	0	<i>Iron</i>	8	6
<i>Calve's Brain, raw</i>	1	4 $\frac{3}{4}$	<i>Ivory</i>	1	21 $\frac{1}{2}$
<i>Camphire</i>	1	4	<i>Lead</i>	12	1 $\frac{1}{2}$
<i>Chalk</i>	1	18 $\frac{1}{2}$	<i>Loadstone</i>	5	12

Marble

^d For the sake of Convenience, and ready Use, this Table is ranged in alphabetical Order; tho there are considerable Ends answered also by disposing it in the natural Order, so as to shew how Bodies run down, in a descending Scale, from the most ponderous Substance, GOLD; to the lightest the Author tried, which was *Fir*. Whence, we judge, that both Forms ought to be preserved; at least till a complete Table of the specifick Gravities of all Bodies is procured: tho on many Occasions, even then, it would be proper to have two; one in the Order of Nature, and the other in that of the Alphabet, according to the present Example. See below, *Observation 3. § 11.*

and RARIFICATION.

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	Penny-Weight.	Grains.		Penny-Weight.	Grains.
Marble	2	22 $\frac{1}{4}$	Salt, common, in } powder	1	10
Marjoram, sweet, in } powder	0	23	Sand, white	1	20
Milk, Cow's	1	4 $\frac{1}{2}$	Saunders, red	1	5
Mint, its expressed Juice	1	4	Sheep's Blood	1	5
Myrrh	1	0	----- Flesh	1	10
Nitre	2	5	Silver, pure	10	21
Oak-wood	0	19 $\frac{1}{2}$	Soot, common, from } the Chimney, in }	0	17
Oil of sweet Almonds	0	23 $\frac{1}{2}$	powder		
— of Cloves, chemical	1	3	Spirit of Wine	0	22
— of Mace, green, } by Expression	0	23 $\frac{1}{2}$	Steel	8	10
— of Sulphur	1	18	Suet	1	0
— of Vitriol	1	21	Sugar, white, pow- } dered	1	2 $\frac{1}{2}$
Onion, fresh	1	5	Tin, block	7	22
Ox Bone	2	5	Tin-glass	10	12
----- Horn	1	6	Touchstone	3	1
Pear, Winter, raw	1	2	Verjuice of Crabs	1	3
Pearl powdered	2	2	Vinegar	1	3 $\frac{1}{2}$
Petroleum	0	23	----- distilled	1	1
Quick-silver	19	9	Vitriol, white	1	22
Rose Flowers pow- } dered	0	22	Urine, common	1	3
Rose-water distilled	1	1	Water	1	3
Sal-Gem	2	10	Wax, yellow	1	2
			Wine, Claret	1	2 $\frac{1}{2}$

The same TABLE in the Order of Nature.

	Penny-Weight.	Grains.		Penny-Weight.	Grains.
Pure Gold	20	0	Block Tin	7	22
Quicksilver	19	9	Loadstone	5	12
Lead	12	1 $\frac{1}{2}$	Touchstone	3	1
Pure Silver	10	21	Marble	2	22 $\frac{1}{4}$
Tin-glass	10	12	Flint	2	22 $\frac{1}{2}$
Copper	9	8	Glass	2	20 $\frac{1}{2}$
Fine Brass	9	5	Crystal	2	18
Steel	8	10	Alabaster	2	12
Common Brass	8	9	Sal-Gem	2	10
Iron	8	6	Common Clay	2	8 $\frac{1}{2}$
V O L. III.			U u u		Tb-

	Penny-Weight.	Grains.		Penny-Weight.	Grains.
<i>Tobacco-pipe-Clay</i>	2	5 $\frac{1}{2}$	<i>Vinegar</i>	1	3 $\frac{1}{2}$
<i>Nitre</i>	2	5	<i>Verjuice of Crabs</i>	1	3
<i>Ox Bone</i>	2	5	<i>Shining Amber</i>	1	3
<i>Powdered Pearl</i>	2	2	<i>Urine</i>	1	3
<i>Brimstone</i>	2	2	<i>Common Water</i>	1	3
<i>Common Earth</i>	2	1 $\frac{1}{2}$	<i>Oil of Cloves, chemical</i>	1	3
<i>White Vitriol</i>	1	22	<i>Claret Wine</i>	1	2 $\frac{1}{4}$
<i>Ivory</i>	1	21 $\frac{1}{2}$	<i>White Sugar, powdered</i>	1	2 $\frac{1}{2}$
<i>Alum</i>	1	21	<i>Yellow Wax</i>	1	2
<i>Oil of Vitriol</i>	1	20	<i>China-Root</i>	1	2
<i>White Sand</i>	1	21	<i>Winter-Pear, raw</i>	1	2
<i>Cbalk</i>	1	18 $\frac{1}{2}$	<i>Vinegar, distilled</i>	1	1
<i>Oil of Sulphur</i>	1	18	<i>Rose-water, distilled</i>	1	1
<i>Common Salt, in powder</i>	1	10	<i>Common Ashes</i>	1	0 $\frac{1}{2}$
<i>Guaiacum wood</i>	1	10	<i>Myrrh</i>	1	0
<i>Sheeps Flesh</i>	1	10	<i>Benjamin</i>	1	0
<i>Aqua fortis</i>	1	7	<i>Butter</i>	1	0
<i>Ox Horn</i>	1	6	<i>Suet</i>	1	0
<i>Indian Balsam</i>	1	6	<i>Oil of sweet Almonds</i>	0	23 $\frac{1}{2}$
<i>Calves Brain, raw</i>	1	4 $\frac{3}{4}$	<i>Oil of Mace, green,</i>	0	23 $\frac{1}{2}$
<i>Sheeps Blood</i>	1	5	<i>by expression</i>		
<i>Red Saunders</i>	1	5	<i>Marjoram, sweet, in</i>	0	23
<i>Jet</i>	1	5	<i>powder</i>		
<i>Fresh Onion</i>	1	5	<i>Petreol</i>	0	23
<i>Cows Milk</i>	1	4 $\frac{1}{2}$	<i>Rose Flowers, powdered</i>	0	22
<i>Camphire</i>	1	4	<i>Spirit of Wine</i>	0	22
<i>Mint, its expressed juice</i>	1	4	<i>Oak Wood</i>	0	19 $\frac{1}{2}$
<i>Borage, its expressed juice</i>	1	3 $\frac{1}{2}$	<i>Soot, common, from</i>	0	
<i>Strong Beer</i>	1	3 $\frac{1}{2}$	<i>the chimney, in</i>		
<i>Ebony Wood</i>	1	3 $\frac{1}{2}$	<i>powder</i>	0	17
<i>Fennel-seed, powdered</i>	1	3 $\frac{1}{2}$	<i>Fir-wood</i>	0	15

The Construction, Nature, and Use of the preceding TABLE.

1. **T**HE Weights made use of are the common ones of the *Gold-Smith* ; *The Weight employed.* the Pound consisting of twelve Ounces ; the Ounce of twenty-penny Weight ; and the Penny-weight of twenty-four Grains. We make choice of *pure Gold* for the *Standard*, and adjust the Dimensions of the other Bodies thereto ; because this is not only the heaviest Substance we know ; but also the most uniform, homogeneous, and without any volatile Part. The Experiments, upon which the *Table* was formed, proceeded thus.

2. We fashioned an Ounce of pure Gold into a solid Cube, and provided *The Table how made.* a square Case, or Box of Silver, which contained and fitted it exactly ; excepting only, that the Case rose somewhat higher : but a Line was drawn on the inside of it, at the precise height whereto the Gold Cube reached. This we did for the convenience of filling the Case with Fluids, and Powders ; so that when either of them were put in, they might not run over, or be spilt ; but contain themselves level within. We likewise provided another similar Case, perfectly of the same Weight and Dimensions ; *The Apparatus.* in order to shew the Proportion which the Body, contained in one, bore to that contained in the other. Then cutting Cubes of the same Dimensions, or Bulk, with that of the Gold, in all the solid Bodies specified in the *Table* which would bear cutting, we fitted them exactly into the Cases, up to the Line ; and poured in our Liquors to the same height occasionally. The like we also did by the Powders ; constantly observing to squeeze and press them in so strong, that they might lie even and uniform, without subjecting our Experiments to casualty.

3. Then for the Trials themselves ; we put one of the Cases, empty, in one Scale, and the other Case, containing the Body to be examined, into the other Scale of the Balance ; and separately took the exact Weight of each Body so contained. For, as much as the Weight of the Body fell short of that of the Gold ; so much the Bulk of the Body exceeded that of the Gold. Thus, for Example, as the Gold Cube weighed an Ounce, and an equal Cube of Myrrh, weigh'd but one Penny-weight ; it follows, that the Bulk of Myrrh is to the Bulk of Gold, as twenty to one : so that there is twenty times as much Matter contained in Gold as in an equal Bulk, or Dimension, of Myrrh ; or again, twenty times as much Bulk, or Distention, in Myrrh, as in an equal Weight of Gold. *The Experiments, how performed.*

A D M O N I T I O N S .

4. (1.) The Vessel here employed, would not, on account of its smallness and Figure, allow the Experiments to be made with any great Exactness : by its means we could not easily take the specific Gravities below a quarter of a Grain ; and the little square Surface of the Matter might, *Imperfection of the present Method, and a better directed,*

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by

by a small and insensible rising, make some difference: so that Vessels rising sharp and conical, are best suited for forming an *accurate Table* of this kind ^e.

Experiments
of specific
Gravities vary.

5. (2.) No doubt but many of the Bodies expressed in the foregoing *Table*, have a greater or less specific Gravity than others of the same kind; so that one Wine shall contain more Matter in the same space, than another; and one Wood more than another Wood of the same Species, &c. And therefore the Business of exact Trials, and settling the accurate Proportions of the specific Gravities of Bodies, is here somewhat uncertain, or casual. Nor can it be expected that the individual Bodies we made our Experiments with, should be a Standard of the Nature and Gravity of each Species; or that they should perfectly agree with the Experiments made by others, in the same manner ^f.

Not made in
three kinds of
Bodies.

6. (3.) We have received into our *Table*, only such Bodies as would commodiously occupy and fill up Space; whilst the Body remained, as it were, entire, uniform, and similar: and such also as have a sensible Gravity in the Air; from which Gravity we might judge of their quantity of Matter. So that there are three kinds of Bodies whereto our Experiments were not applied; viz. (1.) those that are incapable of a cubical Dimension; as Leaves, Flowers, Pellicules, Membranes, &c. (2.) Such as are unequally porous and cavernous; as Sponge, Cork, Wooll, &c. And, (3.) untangible Bodies, whose Weight is not perceived in the Air; as Flame, Air itself, &c. ^g

Whether Bo-
dies may ac-
quire Weight
by Condensa-
tion.

7. (4.) Enquiry should be made, whether, possibly, the close Contraction, or Condensation, of a Body, by an uniform Force on all sides, will give it a greater Proportion of Gravity, than corresponds to its Quantity of Matter. This Enquiry belongs to the *particular History of Gravity* ^h: and, if it terminate in the Affirmative, our Calculation must needs be erroneous; and the more rarified any Body is, it will contain somewhat more Matter under the same Bulk, than is assigned it by our Method ⁱ.

The Table to be
improved.

8. This *Table* I made many Years since; tho, so far as I remember, with tolerable Care and Exactness: but, doubtless, an infinitely more accurate

^e As in *M. Homberg's* Glass, for taking the specific Gravities of Liquors; where a single Drop is made to possess a considerably long Space in the slender graduated Neck.

^f To this may be added the different Seasons of the Year, and Times of the Day; as to Heat and Cold, Dryness and Moisture, &c. All which occasion Variations in very curious Experiments of this kind.

^g These Experiments require the Assistance of the *Air-Pump*.

^h This History the Author intended to write; but it was not published.

ⁱ This Point may now seem settled, by the Industry of the Moderns; since it is shewn, by Experiment, that Quantity of Matter and absolute Gravity are reciprocal; or that the Matter in Bodies corresponds exactly to their Weight. The Question here turns upon the Distinction betwixt *absolute* and *relative*, or *specific Gravity*. *Absolute Gravity* is the Weight of Bodies in a perfect Vacuum, or unresisting Medium: and *relative Gravity*, their Weight in a resisting Medium; which lessens the absolute Gravity of a Body, in proportion to the Density of the Medium. So that the same Body weighs less in Air than in *Vacuo*; less in Water than in Air, &c. Therefore, in the present Case, where the Experiments are made in the Air; the Condensation of a Body, by lessening its Surface, will cause it to be less resisted by the Air; and consequently to weigh the more. But in an absolute Vacuum, the same Body ever so much condensed, weighs no more than the same Body ever so much expanded.

accurate one may be formed, from trying a greater number of Bodies, and in larger Quantities ; which greatly contributes to render the Experiments more just. And this being a fundamental thing in Philosophy, it should by all means be procured^k.

Larger OBSERVATIONS.

9. (1.) 'Tis an agreeable Prospect to see, from such a *Table* as this, *The Limits of Density in Bodies.* how finite and comprehensible the Nature of tangible Bodies is ; for such a *Table* grasps, as it were, all natural Bodies in the Hand. And let no Man here indulge his Fancy, or his Levity ; but consult Experience : for our *Table* shews, that there is no tangible Body in Nature exceeding another in Quantity of Matter, above thirty-two to one ; which is the Proportion wherein *Gold* exceeds *Fir-Wood*. As for Bodies near the centre of the Earth, we can say nothing to them ; since they neither come under our Senses nor Experience : possibly, as they lie very remote from the heat of the celestial Bodies, and are quite cut off from any Communication therewith ; they may be more dense than any of the Bodies we know.

10. (2.) There can be little Justness in that Opinion, which supposes *Bodies not composed of the four Elements.* sublunary Bodies composed of the four Elements. For our cubical Lump of *Gold*, in the *Table*, was twenty Penny-Weight ; whereas common *Earth* is little more than two ; *Water* but one, and *three Grains* ; and *Air* and *Fire* are still vastly more rarified, as being not tangible, and insensible upon the Balance : And *Form* does not increase the Matter of Bodies. It must therefore, on this Footing, be considered, which way a Body of twenty Penny-Weight, can by *Form* be produced, under equal Dimensions, from a Body of two Penny-Weight ; and from others vastly more rarified. There are here two Subterfuges ; the one, that the more rarified Elements squeeze the denser to a greater closeness than the simple Element itself : the other, that the *Peripateticks* do not understand this of common, but of *elementary Earth* ; which is heavier than any compound Substance. But *Fire* and *Air* do not condense Bodies, except by accident ; as we shall shew hereafter^l. And for the *Earth*, which should be heavier than *Gold*, and all other Bodies ; it is so buried, as hardly to be found, and employ'd in Mixture^m. It were, therefore, much better for the *Peripateticks* to leave off trifling, and dictating in Philosophy.

11. (3.) The *Scale of Density* in Bodies, or the Degrees wherein they fall from a closer Texture of Matter, to a looser, should be carefully noted ; and how this sometimes happens by smaller Steps, and sometimes by larger Strides : such a View being of service, not only to inform the Judgment, but

^k There are several Tables of this kind extant ; tho none perhaps so copious and exact as is on many Occasions required. See Mr. Boyle's Piece of *Hydrostatics applied to Ores, and the Materia Medica*. And for the Uses of such a *Table*, see hereafter, § 14, &c.

^l See Sect. VI. and VII.

^m See Mr. Boyle's *Sceptical Chymist*.

but also in leading to Practice. The Density of metalline Bodies is the greatest; and runs eleven Steps downwards, from *Gold* to *Tin*; proceeding by a large start from *Gold* and *Quicksilver*, to *Lead*; but gradually, or slowly, from *Lead* to *Tin*. Again; there is a great Leap from Metals to Stones; only the Loadstone comes in between; which is thence proved to be of a metallic Nature^a. But from Stones to all other Bodies, there is a continued, regular, and slow Descent.

P R E C E P T S.

Whence dense Bodies near the Earth's Surface.

12. (1.) As the Seat of Density may seem to be in the Depth of the Earth; so the Bodies towards its Surface should be considerably rarified: but 'tis very remarkable, that *Gold*, the heaviest of Metals, should sometimes be found, nearly in a pure State, among the Sand and Gravel of Rivers. A careful Enquiry should be therefore made into the Situation of such Places; to discover whether they lie not near the Foot, or below the Bottom of certain Mountains, or deep Mines, from whence the *Gold* may be washed: or, otherwise, what it is that procures so great a degree of Density, near the Surface of the Earth^o.

Mines to be enquired into.

13. (2.) It should also be enquired, as to Mines in general, what kind of them lie the deepest, and what nearest the Surface of the Earth; in what Situation of a Country, and in what kind of Glebe or Soil; how they lie with respect to the Waters; but particularly, in what Beds; and how they are surrounded, or mixed in with Stone, or other fossil Matters. In short, all the Circumstances belonging to them should be examined; in order to find out by what means the Juices and Spirits of the Earth are compacted, and condensed into a metalline Nature, so much heavier than that of other Bodies^p.

Larger OBSERVATIONS.

The lightest Bodies to be enquired after.

14. (1.) No doubt but there are many Bodies to be found, both in Vegetables and the Parts of Animals, much lighter than *Fir-Wood*; for, we conceive that the Downs of some Plants, the Wings of Flies, the Skins of Snakes, and various Matters treated or produced by Art; such as *Tinder*, dry *Rose-Leaves* remaining after Distillation, &c. are not so heavy as the lightest Woods^q.

The vulgar Notion of Density to be rectified.

15. (2.) That erroneous Notion, to which the human Understanding readily inclines, in supposing hard Bodies the densest, should be corrected and

^a Such Particulars as these are frequently taken for late Discoveries.

^o The former is generally allowed to be the Case; viz. that *Gold* is washed down into Rivers, from Mines that lie higher; yet the Question still remains, Whence has *Gold* its Density; being often found in Mines not far below the Earth's Surface?

^p See the Heads of this Enquiry in the *Philosophical Transactions*; or in *Mr. Boyle's Works*, Abridgment, Vol. III. pag 8.

^q See *Dr. Hook's Micrographia* passim.

and restrain'd: for Quicksilver runs, and Gold and Lead are soft; yet these are denser and heavier than the hardest Metals, Iron and Copper; and much denser than Stones.

16. (3.) Our *Table of specific Gravities*, shews many things contrary to Expectation; as that Metals are much heavier than Stones; Glafs, a factitious Body, heavier than Crystal; that common Earth is considerably light; that the Oils, or distilled Liquors of Vitriol and Sulphur, are almost as heavy as crude Vitriol or Sulphur; that the Difference between the Gravity of Water and Wine is not great; that some chemical Oils, which should seem lighter, are yet heavier than Oils by Expression; that Bone is much heavier than Horn or Teeth: with several Particulars to the same effect. *The Table shews Particulars unexpected.*

P R E C E P T.

17. The Nature of *Density* and *Rarity*, tho it runs thro' nearly all other Natures, without being subject to their Laws; yet seems to have a great consent with *Gravity* and *Levity* *. We also suspect it may have an Agreement with the slow and quick Admission, and Rejection, of Heat and Cold. We would, therefore, have trial made, whether rare Bodies do not grow hot and cold, quicker than dense ones. The Experiment should be performed on Gold, Lead, Stone, Wood, &c. with the same degree of Heat, the same Quantity, and the same Figure of the Body †. *Density related to Gravity.*

Praetical HINTS.

18. All the Mixtures of Bodies may be discovered by means of an exact *Table of specific Gravities*, and the Test of Weight. Thus to find what Proportion of Water is mixed with Wine; Lead, with Gold, &c. the Mixture being weighed, and the *Table* consulted, for the respective Weights of the Simples; the mean Proportion of the Compound, compared with the Simples, will give the Quantity of the Mixture. And this we judge was the Method used by *Archimedes*, in detecting the Debasement of King *Hiero's* Crown. *The Foundation of the hydrostatical Balance.*

19. The making of *artificial Gold*, or the *Transmutation of Metals into Gold*, should be held suspect; for Gold is the heaviest and densest of all Bodies; and therefore to convert any thing else into it, is absolutely the Work of Condensation: but Condensation can scarce be super-induced by Men upon the Surface of the Earth; especially in Bodies that are full of Matter, as Metals are. For most Condensations, effected by Fire, are false, or imperfect Condensations, with regard to the whole; and only condense Bodies in certain Parts, as we shall see hereafter †.

20.

* 'Tis now generally esteemed reciprocal thereto. See above, § 7. and below, § 37.

† There are some Experiments to this purpose in *Boerhaave's* Chemistry; particularly in the Chapter of Fire.

‡ Sect. VI. and VII.

The History of CONDENSATION,

The Conversion of Lead or Quicksilver into Silver not desperate Partial Conversions of use.

20. (3.) But the *Conversion of Quicksilver, or Lead, into Silver*, which is a rarer body than either, may rationally be hoped for : as requiring only Fixation, not Condensation.

21. (4.) Yet if Quicksilver, Lead, or any other Metal, could be turned into Gold, in all other properties except Gravity ; or be rendered more fix'd, more malleable, soft, ductile, durable, bright, yellow ; or less subject to tarnish ; it might doubtless prove an useful and gainful Operation.

A larger OBSERVATION.

22. We know of nothing heavier than Gold ; nor has any Method yet been found of increasing the Gravity of pure Gold, by Art^t.

HISTORY.

Lead increased.

23. But Lead has been observed to increase, both in Bulk and Weight ; especially by lying in Cellars under Ground, where Bodies readily grow mouldy. This has principally been observed in Stone Statues ; the feet whereof were fasten'd together with Bands of Lead, that have been found swell'd ; so that some Parts thereof hung prominent, or pendulous, like Warts, upon the Stone. But whether this were really an increase of the Lead, or only a sprouting of its Vitriol, shou'd be farther examin'd[†].

24. A TABLE, shewing the different EXPANSION of BODIES, whole and in Powder.

Penny-Weight. Grains.			Penny-Weight. Grains.		
T	}	THE Cubic Vessel of Crude-Mercury	19	9	
Lead			12	1 $\frac{1}{2}$	
Steel			8	10	
Crystal			2	18	
Red Saunders			1	5	
Oak-wood			0	19 $\frac{1}{2}$	
T	}	THE Cubic Vessel of the close Powder of Mercury Sublimate	3	22	
Ceruse			3	8 $\frac{1}{2}$	
Crocus Martis			2	9	
Crystal, ground			2	20	
Red Saunders, ground			0	16 $\frac{1}{2}$	
Oak-Asbes			1	2	

25. A

[†] The Gravity of Silver is said to have been considerably increased.

[‡] See Mr. Boyle's Works. Abridgm. Vol. III. p. 95.

25. A T A B L E to shew the different E X P A N S I O N S
of B O D I E S, crude and distill'd.

	Penny-Weight.	Grains.		Penny-Weight.	Grains
C Rude Sulphur	2	2	Oil of Sulphur	1	18
Vitriol	1	22	Oil of Vitriol	1	21
Wine	1	2	Spirit of Wine	0	22
Vinegar	1	3	Distill'd Vinegar	1	1

A D M O N I T I O N.

26. The manner of reducing a Body to Powder, contributes greatly to the opening, rarifying, or expanding of that Body. But the reduction of a body to Powder by simple triture, or by filing, is one thing ; by chemical Sublimation another ; by Corrosion with acid Spirits, another ; and by Calcination, another ; so as to have very different Effects. *The different kinds of Pulverization, rarify differently.*

P R E C E P T.

27. These two Tables are extremely scanty and defective ; but that wou'd be an exact and copious one of Bodies and their Expansions, which in the first Column contain'd the weight of each Body ; in the second the weight of its crude Powder ; in the third, that of its Ashes, Calx, or Rust ; in the fourth, that of its pappy Mass ; in the fifth, that of its Vitrification, if it be vitrifiable ; in the sixth, its Matter by Distillation ; in the seventh that of its Solution, subducting the weight of Liquor that dissolves it ; and so on, till it exhibits the weights of the same Body under all its Changes, and other Alterations : from which Table a judgment might be form'd of the relaxations of Bodies, and the closest integral Connexions of Nature. *The preceding Tables so be improved.*

O B S E R V A T I O N.

28. Pulverization is not properly a rarification of the Body pulverized ; because the increase of Bulk proceeds not from the dilatation of the Body ; but from the interposition of Air : yet an estimate of the internal Connexion, or porosity of Bodies may be excellently derived from it. For the closer Bodies unite, the greater difference there is between their Powder and entire Body : and therefore Quicksilver is to Mercury-Sublimate in Powder, as above five to one ; and the proportions of Steel and Lead to prepared Steel, and Ceruse in Powder, are not so much as four to one. But in the lighter and more porous Bodies, there is sometimes a looser position of Parts, in the wholes, than in the press'd Powders ; so the Ashes of Oak-wood are heavier than Oak itself. And again, in Powders, the heavier the entire Body is, the less

less Dimension its squeez'd Powder has, in Comparison of another unsqueezed : for in light Bodies the Parts of Powders may sustain or support themselves ; so that an unsqueezed Powder shall possess thrice the space of a squeezed one ; on account of its less condensing, and dividing the Air interposed betwixt its Parts.

Wine made much lighter than Vinegar by Distillation.

29. (2.) Distill'd Bodies are generally rarified, and made light, by the Operation ; but Wine twice more than Vinegar.

A Speculation for Practice.

Tangible Bodies reducible to Classes, according to their specific Gravities.

30. And thus tangible Bodies may be reduced under Classes, according to their Families ; or as they prove rich or poor in Matter. But there is another Class of Things, which we call pneumatical, or untangible ; so that not being subject to the Balance, no judgment can be form'd of the Distention, or Rarification, of the Matter they contain. Whence this Affair requires another kind of *Interpretation*. But first ; the several Species of pneumatical Bodies are to be laid down ; that they may be compared with each other. But as in the Case of tangible Bodies, we for a time postpone the Consideration of the internal Parts of the Earth ; so in the Case of pneumatical Bodies, we postpone for a time, those that are ethereal.

Pneumatical Bodies classed. The imperfect.

31. We range *pneumatical Bodies* under three general Classes ; viz. (1.) The *imperfect* ; (2.) the *confined* ; and (3.) the *pure*. (1.) The imperfect are, *Fumes* of all kinds, proceeding from different matters. These may stand in this order ; 1. *Volatile Fumes* that breathe out from Metals and some other Fossils ; being, as their Name imports, rather volatile than pneumatical ; and very easily coagulated either by Sublimation or Precipitation. 2. *Vaporous Fumes*, expiring from Water and aqueous Bodies. 3. Under the general Name of Fumes, we likewise include the *Expirations of dry Bodies*. 4. *Exhalations* proceeding from oily Bodies. 5. *Breaths* afforded by Bodies aqueous in their Substance, but inflammable in their Spirit ; as in Wines, and other fermented spirituous Liquors.

After-Fumes.

32. There is also another kind of Fumes in which Flame terminates ; and such as expire only from inflammable Bodies, consequent to the Flame : and these we call *After-fumes*, or *Secondary-fumes*. So that there can be no *After-vapours*, because aqueous Bodies are un inflammable ; but there may be *After-fumes*, in our particular Sense, as also *After-exhalations*, *After-breaths*, and probably *After-volatile* Parts in some Bodies.

Confined and pure pneumatical Bodies.

33. (2.) But *confined pneumatical Bodies* are those found, not independent or free, but included in tangible Bodies ; and are what we commonly call *Spirits*. These participate both of an aqueous and oily Substance ; and are nourished and fed thereby : and being converted into a pneumatical Substance, they constitute a Body, as it were consisting of Air and Flame ; and thence produce the strange effects of both *. These Spirits, with regard to

* See the *Axioms* at the End of the History of Life and Death.

to pneumatical Bodies that are free and at large, nearly approach to the nature of *Breaths*; such as arise from Wine, &c. And these Spirits are of two kinds; the one of crude and the other of living Bodies. The *crude Spirits* are contained in all tangible Bodies; but the *living Spirit* only in such as are animated, whether of the vegetable or sensitive Kingdom. (3.) But there are no more than two *pure pneumatical Bodies*, viz. *Air* and *Flame*; tho' these also are subject to great diversity, and receive very unequal degrees of Extension.

34 A T A B L E of *pneumatical Bodies*; conformable to the preceding Speculation^{*}; as they receive, in Order, a greater degree of Extension.

T H E *volatile parts of Metals and Fossils.*
The *After-volatile parts of the same.*

Vapours.

Fumes.

After-Fumes.

Exhalations.

After-Exhalations.

Breaths.

After-Breaths.

Crude Spirits, confined in tangible Bodies.

Air.

Living Spirit, confined in tangible Bodies.

Flame.

35. We are next to consider the respective Extensions of these pneumatical Bodies; as well with regard to themselves, as to tangible Bodies. And here it might be well, if the Nature of Levity, by an ascending Scale, wou'd elucidate and correspond to the Rarification of Bodies; as the Nature of Gravity, by a descending Scale, does to their Density. But several Difficulties interpose: as first, that the Differences of the Motions in Objects invisible, are not immediately perceived by the Senses. Secondly, that in Air, and the like Substances, there is not found so strong an Appetite of moving upwards, as Men imagine. And lastly, if the Air did move upwards; yet, as it is generally continued along with other Air, the Motion wou'd be difficultly perceived. For as Water does not preponderate in Water; so Air does not rise up against, and displace Air. And therefore other Methods must be invented ^{Levity affords not a corresponding Scale to Gravity.}

X x x 2

36. There

^{*} § 28.

^x If this wants any illustration, see above § 8. See also hereafter § 37.

The Expansions of pneumatical Bodies hard to assign.

36. There are certain considerable Proofs of the proportionate Expansions of pneumatical Bodies, with regard to each other; shewing also at the same time, that the Series of Rarification express'd in the *Table*, has a solid Foundation: but for the precise degrees of this Expansion, and the comparative Expansion of a pneumatical with a tangible Body, the Enquiry is more difficult.

Fumes less rare than Air.

37. All *Fumes*, whether primary or secondary, do not, 'tis highly probable, come up to the rarity of the Air; they being visible; but the Air invisible: nor do they themselves remain visible after being mixed along with the Air.

After-fumes rarer than Fore-fumes.

38. 'Tis manifest that *After-fumes* are more subtile, and rarified, than *Fore-fumes*; as being no other than the Calxe's and Resolutions of that subtile Body Flame itself. And so it appears from Experience, that tho numerous Lights continue for a long time burning in a Room, or large Assembly, the Air is not thereby unfitted for Respiration; notwithstanding so many *After-fumes* are received into it: but if the Lights were to be extinguished, and their *Fore-fumes*, or fuliginous Steams, to be received instead of the former; the Air wou'd soon prove suffocating to the Company.

Crude Spirits denser than Air.

39. We likewise judge that all *crude Spirits* confin'd in tangible Bodies, are denser than Air: for the Spirits of Vegetables, dead Creatures, or the like, do, upon their Exhalation, manifestly detain some gross, or tangible Parts; as appears from Odours; which being nothing but Fumes going out sparingly, and a little at a time; (as we see in such Fumes and Vapours as are visible;) yet if they meet with any suitable, or soft, tangible Body, they apply themselves to it, stick therein and communicate their Odour: whence, 'tis plain, that they obstinately retain an affinity with gross Bodies.

Living Spirits rarer than Air.

40. But we conceive *living Spirits* to be somewhat rarer than Air; because they are a little like Flame^y; and again because, upon careful Experience, we have found that Air has no power to diminish Weight: for a blown Bladder is not lighter than an empty and compressed one; nor is a Sponge or a Fleece of Wool full of Air, lighter than the same when empty, or with the Air squeezed out. But the Bodies of Animals differ sensibly in their Gravity before and after Death; tho not so much as is commonly conceived^z. Therefore *Air* seems not at all to diminish Gravity; as the *living Spirit* appears to do: and as Weight is the Criterion of *Density*; so the diminution of Weight shou'd be the Criterion of *Rarity*^a.

41. Flame

^y See the *Axioms* at the End of the History of Life and Death.

^z It shou'd seem as if the Author had made some Experiments about the weight of animal Bodies alive and dead; and that these Experiments did not agree with those of Mr. Boyle; who upon weighing a live Mouſe and a Kitten, then strangling them, and immediately weighing them again, found them a little lighter. See *Abridgm.* Vol. II. p. 527. This matter requires to be farther prosecuted; and at the same time it shou'd be fully tried, whether Eggs gain in weight upon their Animation.

^a See § 15. Let the distinction of *specifick* and *absolute* Gravity, be well remember'd; and that in common weighing, the Experiment is made in a gravitating Fluid. Thus if the Body collapse, or shrink, after Death, it might when weigh'd in Air, prove heavier upon the Balance, than when alive. This Affair seems subject to many Contingencies: and it requires great Caution to make a valid Experiment therein.

41. *Flame* comes last in this Series ; because *Flame* manifestly ascends : *Flame rarer than Air.* and again, because the Natures of pneumatical Bodies differ not from those of the tangible Bodies that supply them. And, therefore, as Oil is rarer than Water ; so *Flame* shou'd be rarer than Air, and Spirit. Again, *Flame* seems to be a thinner, softer, and more yielding Body than Air ; since the lightest Commotion of the Air near a burning Taper, will cause the *Flame* to tremble.

H I S T O R Y.

42. How great soever the difficulty might be of discovering the Expansion of a pneumatical, with regard to a tangible Body ; yet we have not despaired thereof : and it seems to us a very certain kind of Proof, if any tangible Body of a known Expansion, cou'd be converted into a pneumatical Body ; and then the Expansion of that be likewise observed ; so as, from a Comparison of the two Proportions, an evident Demonstration might be had of the Dimensions upon the Rarification. *How to discover the Expansion of a pneumatical, with respect to a tangible Body.*

43. We, therefore, took a small glass Vial, capable of containing about an Ounce ; and poured into it half an Ounce of Spirit of Wine ; which being the lightest of Liquors, comes nearest to a pneumatical Nature : then taking a new and large Bladder, capable of containing a Gallon, and squeezing all the Air out of it, as exactly as possible, till the sides came close together ; and also rubbing its outside well with Oil, to make it still more close and pliable ; we tied its Neck tight, over the mouth of the Vial, with a wax Thread. - We now placed the Vial over warm Embers in a Chaffing-dish ; when presently the Vapour of the Spirit of Wine ascended into the Bladder : and strongly inflated it every way. Then immediately removing the Glass from the Fire, and pricking a Hole in the top of the Bladder, that the Vapour might rather get out, than fall back into Drops ; we took the Bladder away from the Vial, and examin'd by the Balance what proportion of the half Ounce of Spirit was wanting, or turned into Vapour ; and found it to be not more than six penny-weight : so that six penny-weight of Spirit of Wine, which in that state did not possess above one fortieth part of a Pint, being turned into Vapour occupied the space of eight Pints. *An Experiment for the purpose.*

A D M O N I T I O N.

44. The Bladder began to grow somewhat flaccid upon being removed from the Fire ; so that notwithstanding such a considerable Expansion, the Vapour did not seem converted into a pure and fix'd pneumatical Body ; but inclined to recover itself. And this Experiment may prove fallacious, if it be hence conjectured that common Air is still rarer than this kind of Vapour ; because we conceive that Spirit of Wine turn'd pneumatical, tho' but imperfectly, does, by reason of the Heat, exceed the rarity of cold Air ; as Air itself is by Heat dilated very considerably, and greatly exceeds the Expansion *The Experiment how to be understood.*

The History of CONDENSATION,

Expansion of cold Air. Whence we judge that if the Experiment were made with Water, the degree of Expansion wou'd be much less ; tho the Body of the Water contained more Matter than Spirit of Wine.

HISTORY.

*Expansion of
Flame greater
than Fume.*

45. If the Fume proceeding from a Wax-taper, newly put out, be view'd, and an Estimate be form'd of its Dimensions by the Eye ; and again, if the Body of the Fume be afterwards set on Fire, the Expansion of the Flame will appear to exceed that of the Fume, as about two to one.

ADMONITION.

*An apparent
contradictory
Phænomenon
reconciled.*

46. A few Corns of Gunpowder being set on Fire, there appears to be a great Expansion made, with respect to the Body of the Powder ; tho when the Flame is extinguish'd, the Body of the Fume expands itself much more. But let it not hence be supposed, as if the tangible Body were more expanded in Fume than in Flame ; the reason of the Phænomenon being this ; that Flame is an entire Body, but Fume a Body mix'd with a much larger Portion of Air : and therefore ; as a little Saffron tinges a large quantity of Water ; so a little Fume diffuses itself in a large proportion of Air. For a thick, dense Fume, not diffused, appears less than the Body of Flame ; as we before observed.

HISTORY.

*Oil turn'd into
Flame.*

47. A piece of fresh Orange-peel being suddenly squeezed betwixt the Fingers, and directed to the Flame of a Candle ; there starts out a dewy oily, aromattick Matter, in fine Drops ; that makes a very large Body of Flame, in respect of those little Drops.

A larger OBSERVATION.

*The Aristote-
lian Notion of
the rarity of
the Elements
fictitious.*

48. That *Peripatetical* Fiction, as to the rarity of the Elements being in a tenfold Proportion to one another, is arbitrary and hypothetical : for 'tis certain that Air is, at least, a hundred times rarer than Water ; and Flame a hundred times rarer than Oil ; and that Flame is, at least, ten-times rarer than Air.

ADMONITION.

*The preceding
Enquiry not to
be misconstrued.*

49. This Enquiry and Speculation, about pneumatical Bodies, shou'd not be thought too subtilt or too curious ; because 'tis certain that an omission, and want of attending to it, has stupefied both *Philosophy* and *Medicine* ; and rendered them, as it were, Planet-struck in the true investigation of *Causes* : whilst they have unprofitably attributed those Things to *Qualities*, which are
owing

owing to *Spirits* ^b. And so much for the Enquiry into the Expansion of Matter in Bodies, according to their different Consistencies, whilst at rest.

S E C T. II.

Of DILATATIONS caused by simple INTROSUSCEPTION, or the admission of one Body into the Pores of another.

A D M O N I T I O N.

I T wou'd not have been difficult for us, to have reduced the following *scattered History*, to a better Order, and Method ; and to have ranged similar *Instances* by themselves : but we avoided this exactness for two Reasons ; *First*, because many of the *Instances* are of a doubtful Nature, and bear relation to several Things : whence an exact Method, in this Case, wou'd either cause Repetition, or be apt to deceive. *Secondly*, The principal Reason of our rejecting an exact Method at present, is because *we would have the Work lye open to every Man's Industry and Imitation*. But if this Collection of *Instances*, shou'd have been disposed in any artificial, and extraordinary Method ; many, doubtless, wou'd have despaired of performing any thing equal to this Enquiry. We, therefore, direct, both by our own Example and Admonition, that every one in procuring and proposing *Instances*, wou'd use his own Judgment, Memory and Convenience. 'Tis sufficient to have the Enquiry proceed by Writing, and not by Memory, (which indeed wou'd be ridiculous, in such a multitude of *Instances*.) so that it may be afterwards brought to perfection by the *Light of Induction* ^c. And it must be well remembered, that in this Work, *we only collect ALMS and TRIBUTE from the Senses, for the Treasury of the Sciences* ; without proposing Examples for the illustration of *Axioms* ; but endeavouring after Experiments for the formation of *Axioms*. We shall not, however, be wholly regardless of all Arrangement in our *Instances*, but place them so as they may afford Light to each other.

A strict method here purposely neglected.

Unconnected HISTORY.

2. No wonder if the Dilatation of a Body ensues upon the Introsusception of another Body ; since this is plainly an Augmentation or Addition ; ^{Dilatation upon Introsusception, no proper tho}

Rarification.

^b See the *Axioms* to the History of Life and Death. Pag. 418 &c.

^c The *Directions* and *Examples* deliver'd in the second Part of the *Novum Organum*, shou'd be well remember'd thro the Course of the Author's *particular Enquiries* ; as being what himself had a constant regard to. And we are persuaded, that one half of the Use and Excellence of his *Enquiries*, is not perceived by the generality of Readers, for want of attending to this Intimation.

tho not a genuine Rarification. But where the Body, thus received within the Pores of another, is of the pneumatical kind; as Air or Spirit; or if it be a tangible Body, that slides gradually in, and slowly insinuates itself; this is commonly accounted rather a Tumefaction than an Addition.

*Distanced in
tenfile Bodies.*

3. Tensile or extendible Bodies, as Bladders, Bellows, &c. are inflated and distended by the entire Body of the Air; so as to become hard, and capable of being struck, toss'd, and projected. And a bubble of Water is like a Bladder; but for its fragility and tenderness.

*Liquors mix'd
with Air.*

4. Liquors poured from on high, out of one Vessel into another, or strongly agitated with a Spoon, the Wind, the Breath, &c. are mix'd in along with the Air; and thus raised into Froth: but soon afterwards, they subside and shrink into less space; the Air escaping again, as the little bubbles of the froth break away.

Bubbles:

5. Children, for Diversion, make Castles of Bubbles, by blowing with a Pipe into soapy Water; which thus becoming somewhat tenacious, a very small quantity of Water is made to possess a large space, by the Air received within it.

*No frothy
mixtures of
Flame and
Air.*

6. But 'tis not found that Flame can thus be mix'd, and made frothy with Air, by the inflation of Bellows, or other external agitation; so as to constitute a mix'd Body of Flame and Air, like to Froth; which is a mixture of Air and Liquor.

*Yet Flame and
Air are mix'd
in Gunpowder.*

7. On the contrary, 'tis certain that by internal mixture in a Body, before it is set on Fire, a mix'd Body may be made of Air and Flame: for *Gunpowder* has unflammable Parts from the *Nitre*, and, its inflammable Parts principally from the *Sulphur*; whence the Flame of *Gunpowder* becomes whiter or paler than other Flames^d; tho that of *Sulphur* alone be bluish; insomuch that the Flame of *Gunpowder* may be justly compared to a most expansive Froth, or a kind of a fiery Wind, composed of Flame and Air^e.

*Powders com-
posed of Air,
and the pul-
verized Body.*

8. But as Froth is a Body compounded of Air and Liquor; so are all Powders composed of Air and the small Parts of the pulverized Body: whence they differ from Froths, only as contiguous differ from continuous Bodies. For the great bulk of them is caused by the Air; which distends, or sets the Parts of the Body at a distance; as appears from the *second* and *third Table* above laid down^f.

*Tumefactions
in Animals.*

9. There are Tumefactions in the Bellies, and other Parts of Animals, arising from Flatulency, and an aqueous Humour collected within; as in the Case of the Tympany, Dropsy, and the like.

*Powwing Pi-
geons.*

10. There is a kind of Pigeon, which shrinking its Head within its Neck, pouts and swells, considerably.

II. In

^d Except that of Camphire, and certain artificial mixtures, as in the Compositions of the Stars for Sky-Rockets, &c.

^e The more intimately the Thing is consider'd, or rather, the more Experiments are made to give a proper Information therein; as by the Analysis of Nitre, Gunpowder, &c. the more just the Comparison may, perhaps, appear.

^f Sect. I. §. 22, 23.

10. In the Action of Respiration, the Lungs alternately expand and contract, while they receive and discharge the Air, like a Pair of Bellows. *Respiration.*

11. The Breasts of pregnant Females swell, and grow turgid, from the milky Humour contained within them. *Swelling of the Breasts.*

12. The *Penis* of the Male is greatly dilated, in Bulk, upon *The Penis*. Erection.

13. Observe the Breadth of the *Pupilla* of either Eye in a Looking-glass, *The Eyes*. then close the other Eye ; and you will perceive the *Pupilla* of the open Eye manifestly dilated : the Spirits that served for both Eyes, now flowing into one.

14. The Cracks and Fissures of Bowls, and the like Materials of Wood, being contracted by Dryness, are filled up and consolidated, by lying for awhile in Water ; and receiving it within their Pores. *Dry Wood-work, in Water.*

15. There is a kind of *Fungus* growing upon a Tree, and called by the Name of *Jews-Ears*, that being put into Water swells exceedingly ; which Wooll and Sponge do not ^a. And so much for the *Introsusception* of a different Body ; which is, in reality, but a false kind of *Rarification*. *Jews-Ears.*

S E C T. III.

Of the D I L A T A T I O N S proceeding from the INNATE SPIRIT, expanding itself.

T R A N S I T I O N .

1. **W**E pass on to the Dilatations and Tumefactions made in Bodies, by their *innate Spirit* ; whether these Tumefactions and Dilatations be *natural*, or *præternatural*, as they are called ; yet, without Fire, or manifest external Heat: tho in these Cases also there may sometimes follow an Addition, or Introsusception of Moisture, besides the simple *Dilatation* itself. *Dilatation and Tumefaction, natural and præternatural.*

2. Must, new Wines, or other fermenting Liquors, when put up into the Cask, swell and rise considerably, so as to burst the Vessel, unless they get Vent: and when Vent is given, they heave and froth over, as if it were by Ebullition. *Instances in fermenting Liquors.*

3. Spirituous Liquors being close confined, or hard stopt down in Bottles, often burst them with a great Force ; and sometimes throw out the Cork, or Stopple, almost like a Bullet out of a Gun. *Vinous Liquors after Fermentation.*

4. The Seeds of Plants, as of Pease, Beans, &c. are observed to swell a little, before they strike Root, or shoot into a Stem. *Seeds.*

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Y y y

5. Trees

^a Especially if boiled in Water ; where they swell to five or six times their own Dimensions, when dry.

^b Let the Number of these *Instances* be augmented.

- Tears of Trees.* 5. Trees swelling with their native Juice and Spirit, sometimes burst their Bark, and thence discharge Gum and Tears.
- Gems.* 6. Many of the Gems seem to be Eruptions of pure Juices, strained thro' the Rocks: for both Gums and Gems appear, from their Transparency and Splendor, to be strained and depurated Juices; so that even Rocks and Stones may swell with their native Spirit ⁱ.
- Animal Sperm.* 7. And no doubt, but in the Sperm of Animals, in the first Act towards Vivification there is a certain Expansion of the Mass.
- Vitriol.* 8. Vitriol shoots out an Efflorescence, and sprouts or grows, almost like a Tree ^k.
- Stones.* 9. Stones, with Time and Age, shoot out a Salt, especially in moist places, that resembles Nitre ^l.
- Earth swelling with Nitre.* 10. All Glebe-Earth swells with Nitre; for any kind of Ground that remains covered, and heaped up, so that its Juice shall neither be exhausted by the Sun and Air, nor consumed in the growing of Vegetables, will collect Nitre, as an internal Tumefaction. Hence in certain Parts of *Europe* they make artificial Mines of this Salt, by preserving and storing up Earth in Houses prepared for the purpose, and excluding the Rays of the Sun ^m.
- Dilatation in Sweat.* 11. Sweat, in Animals, proceeds from a Dilatation of the Spirits; and, as it were a Liquefaction of the Juices, by Motion.
- The Pulse.* 12. The Pulse of the Heart and Arteries, in Animals, proceeds from the never ceasing and alternate Dilatation and Contraction of the Spirits ⁿ.
- Voluntary Motion.* 13. So, likewise, the voluntary Motion of Animals, which in the more perfect kinds of Creatures, is performed by means of the Nerves, seems to have its Foundation, first in the Compression, and then in the Relaxation of the Spirits.
- Tumors.* 14. A Tumor follows upon the Contusion of any Limb, in Animals; and frequently also upon Pains.
- Stinging, and Bite of a Viper.* 15. The Stinging of Wasps and Bees, produces a large Tumefaction, in proportion to the Wound; but the Bite of a Viper does this in a still greater degree.
- Nettles.* 16. Nettles, Bryony, and the like, raise the Skin, and cause Blisters upon it.
- Poison.* 17. The Swelling of the Face, or Body, is accounted an evident Sign of Poison; especially of that kind which operates by a malignant Quality, and not by Corrosion.
- Blisters.* 18. In the common Blisters made by Cantharides, there arises a watery Humour, or Ichor, which flows out upon pricking or cutting of the Skin.

19. All

ⁱ See Mr. Boyle of the *Origin and Virtues of Gems*.^k Particularly the artificial Vitriols of *Silver*, and *Iron*, as we see very remarkably in the *Arbor Diana*, and *Arbor Martis*, as they are called. See several curious Papers upon this Subject in the *French Memoirs*.^l Of this see Glauber in his *Prosperity of Germany*; and Stubbs's Answer to Henshaw's *History of Nitre*. Consider also of the Iccles in Wine-Vaults, &c.^m See M. Lemery's two Papers of the *Origin of Nitre*, in the *French Memoirs*; and compare them with the Account of Glauber.ⁿ Let this be carefully compared with what is delivered relating to the same purpose in the *Author's History of Life and Death*.

19. All Pustules proceeding from an internal Cause, and the like Eruptions, and Impostumations, bring on apparent Tumors, and raise the Skin [°]. *Pustules.*

20. Sudden Anger, in some, inflates the Cheeks; so likewise does Pride and Haughtiness. *Anger and Pride.*

21. The Bodies of the Frog and the Toad are subject to Tumefaction; and many other Animals, in the way of Fierceness, bristle up their Combs, Hair, or Feathers; from a Contraction of the Skin, by means of a swelling of the Spirits. *Animals swelling.*

22. Turkey-cocks swell themselves greatly, and bristle up their Feathers a-strut. And Birds, while they sleep, have their Bodies somewhat tumid; the Spirit being then dilated by the natural Heat of the internal Parts. *Birds.*

23. The native Spirits of a Body begin to swell, in all cases of Rottenness, and Putrefaction; when these Spirits hastening to come forth, dissolve and alter the Texture of the Body: and if its Structure be somewhat viscous and tenacious, so as to prohibit their Exit, they contribute to the Production of new Forms; and then generate Insects, Worms, &c. but the Origin of this Act is, from the Dilatation of the Spirits [°]. *Putrefaction.*

24. Nor does the Spirit, confined in Putrefaction, contribute only to the Production of living Creatures; but also produces the Rudiments of Vegetables: as appears in Moss; and the Roughness on the Coats of some Trees. *Vegetation.*

25. Having once, by accident, left a cut Citron in a Parlour, for two Months in the Summer; I afterwards found a sprouted Putrefaction on the part that was cut, appearing to rise in certain Hairs, the height of an Inch; and on the Top of each Hair grew a Head, like the Head of a small Iron Nail; thus plainly beginning to resemble a Plant [°].

26. In like manner Rust is produced on Metals; Scurf on Glafs, &c. from the Dilatation of the native Spirit, which swells, and drives the grosser Parts before it; so as to thrust them out at the Surface [°]. *Rust.*

27. It should be examined, whether the Earth swells on its Surface; especially where the Glebe lies spongy and hollow. There have sometimes been found Trees, like the Masts of Ships, lying buried under Ground, to the depth of several Feet: whence it should seem, that such Trees were once blown down by Storms; and that the Earth gradually raised itself over them [°]. *Whether the Earth swells.*

Y y 2

28. The

[°] As in the Small-Pox, &c. Here also might be mention'd the swelling of the Tongue and Head upon Salivation, &c.

[°] This Instance should be well consider'd, as to its Juſtneſs; or rather, a competent Set of Experiments ſhould be made to determine the Fact: for it appears not exactly determined at preſent.

[°] This Experiment ſeems not contingent but conſtant. And the curious microſcopical Obſervers have made ſeveral Species of theſe kinds of *Superſtations*, or Vegetations upon Vegetables. See Mr. Boyle, Dr. Hook, Dr. Grew, the *French Memoirs*, &c.

[°] If the *Cauſe* of Ruſt were here juſtly aſſigned; ought not the ſame Effect to happen in *Vacuo*? The Fact may deſerve to be better enquired into; the ſeveral ways of making *Crocus Martis* conſider'd; the Compoſition and Faults of Glaſs examin'd, &c.

[°] See the Account of the Generation of Moſſes, in the *Philophical Tranſactions*. See alſo Mr. Evelyn's *Sylva*.

Earthquakes.

28. The Earth swells, manifestly and suddenly, in Earthquakes; at which time there frequently burst forth Springs of Water; Wreaths, and Globes of Flame; violent and strange Winds; and Stones and Ashes are tossed into the Air.

29. But all Earthquakes are not sudden; for sometimes the Earth continues in a Tremor several Days: and in our time there was, in *Herefordshire*, a very small, gentle, and slow Earthquake; wherein some Acres of Land continued gradually moving for a Day together; and then transferred themselves into another Place that lay not far off, upon a Declivity; and there rested.

Tumefaction of the Sea.

30. It should be examined, whether the Body of the Waters does sometimes swell in the Seas; for the Flux of the Sea must either happen, (1.) from a progressive Motion; (2.) the rising of the Waters upwards, by some attractive Virtue; or else, (3.) from some Tumefaction or Relaxation in the Waters themselves. And this latter, if it be any Cause of the flowing of the Sea, belongs to the present Enquiry.

In Wells.

31. The Water swells and falls again in certain Springs and Wells; as if it were in the way of ebbing and flowing.

32. There also sometimes break out, in certain Places, Springs of Water, without any preceding Earthquake; and this in certain Periods of Years, from uncertain Causes. Such Eruptions of Water generally happen in great Droughts.

Sea swelling against Storms.

33. It should likewise be observed, that the Seas sometimes swell out of the time of Flood; and without any external Wind: and that this generally precedes some great Tempest or Storm.

P R E C E P T.

Whether small Parcels of Water do not expand.

34. 'Tis worth trying, whether some Relaxation may not happen in the Body of Water, even in a small Quantity. But to expose Water to the Sun or Air, would rather consume it; therefore the Experiment should be made in a close Glass. For example, into a large bellied Glass, having a long and slender Neck, pour so much Water as may fill the Belly, and lower part of the Stem. Let this be done in a dry Season, when the Wind stands northerly; and let the Glass remain thus till the Weather becomes rainy, and the Wind southerly; then observe whether the Water rises at all in the Neck of the Glass. A careful Enquiry should also be made about the swelling of Water in Wells; as, whether it happens more by night than by day; and at what Season of the Year.

H I S-

^t This kind of local Motion, likewise said to happen in certain sandy Desarts, requires to be farther examined.

^v See the *Novum Organum*, Part II. Aph. 36.

^u See *Nov. Organ.* Part II. Aph. 13. (38.)

HISTORY.

35. (1.) In rainy Weather, the Pegs of Violins become swell'd, and hard *Wood-work* to screw; so likewise wooden Drawers are harder to draw out, and Doors *swelling* with wooden Hinges, harder to open in wet Weather.

36. (2.) The Strings of a Violin are apt to break, when tight stretch'd *Musical Strings* in rainy Weather.

37. (3.) The Humors in the Bodies of Animals, are observed to be re-*Humors of Animals* lax'd, to swell, to run, to oppress, and block up the Pores most, in rainy Weather, and southerly Winds.

38. (4.) 'Tis a received Opinion, that the Humors and Juices, not only *Juices of Plants* in Animals, but also in Plants, swell and fill up the Cavities most about the Full of the Moon.

39. (5.) Salts dissolve, open, and dilate themselves in moist Places; so *Salts* likewise, in some measure, do Sugar and Sweet-meats; which are apt to grow mouldy, unless they stand in a Room where a Fire is sometimes kept.

40. (6.) All Things that have passed the Fire, and are considerably *Things dried by Heat* shrunk, grow somewhat relaxed with Time.

41. (7.) Diligent Enquiry should be made into the Tumefactions and *The Air* Relaxations of the Air; and how far the Causes of the Wind depend upon them: since Vapours are neither commodiously collected into Rain, nor dissipated into clear Air, without causing Swells in the Body of the Air *.

SECT. IV.

Of the DILATATION and RELAXATION of Bodies, by the means of Fire, and actual, simple external HEAT.

TRANSITION.

1. FROM the Heap of Nature, we have above taken a few Instances of the Dilatation of Bodies owing to their native Spirit; whether in Maturations, the first Rudiments of Generations, the Excitations by Motions, natural and preternatural Irritations, or in Putrefactions and Relaxations: we next come to those Openings and Dilatations procured by Fire, and actual external Heat.

ADMO-

* See the *History of Winds*, passim.

ADMONITION.

Relaxations by Fire concern this Enquiry. 2. The Relaxations of Bodies by *Heat* or *Fire*, properly belong to the *Titles* of *Heat* and *Cold*, the *Motion* of *Dilatation*, and those of *Separations*, and *Alterations*: but they must be touched under the present *Title*; because, without a little knowledge of them, the *Enquiry* of *Density* and *Rarity* cannot be well conducted.

HISTORY.

Air dilated by Heat. 3. (1.) Air is simply dilated by *Heat*: for in this Case there is nothing separated or emitted, as in tangible Bodies; but barely an *Expansion* made.

Cupping-glasses. 4. (2.) In the case of *Cupping-glasses*, when the *Glass* and the *Air* it contains, are heated, the *Glass* is applied to the *Skin*; and soon after, the *Air* which was dilated by the *Heat*, gradually contracts itself, as the *Heat* decreases; upon which the *Flesh* is thrust into the *Glass* by the *Motion* of *Connexion*^x. If it be desired that the *Cupping-glass* should draw stronger; let a *Sponge* be dipt in cold *Water*, and applied to the *Belly* of the *Glass*: for by this *Coolness*, the internal *Air* will be more contracted, and the *Attraction* of the *Glass* increased^y.

A hot Glass in Water. 5. (3.) If a *Glass* be heated, and inverted into *Water*, it will attract the *Water*; so as to fill a third part of the *Cavity*: whence 'tis plain, that the *Air* was rarified by the *Heat*, in that *Proportion*. But if, instead of a thin *Glass*, which will not bear a great *Heat* without danger of breaking; an *Iron* or *Copper Vessel* were employ'd, and heated to a greater *degree*, we judge that *Air* might be dilated above twice or thrice more; which is an *Experiment* very well worth trying: as likewise, to ascertain the *degree* whereto the *Air* may be rarified; that we may the better judge of its *degree* of *Rarification* in the upper *Regions*; and thence of the *Æther* itself^z.

Thermometer. 6. (4.) It appears very plain, from the *Thermometer*, that a small increase of *Heat* may prodigiously expand the *Air*; so that the *Hand* laid upon the *Glass*, a few *Rays* of the *Sun*, or even the *Breath* of the *By-standers*, shall affect it: nay, the tendencies of the external *Air* to *Cold* and *Heat*, tho' imperceptible to the *Touch*, do yet constantly dilate and contract the *Air* in the *Glass*^a.

Hero's Altar. 7. (5.) *Hero* describes an *Altar* built so artificially, that when the *Offering* is light up thereon, *Water* shall of a sudden descend, and put out the *Fire*.

^x See this *Motion* explained in the *Novum Organum*, Part II. Sect. II. *Aph.* 48.

^y This Explanation in some measure holds, notwithstanding the present manner of accounting for Effects of this kind, from the direct pressure of the *Air* without; and its *Rarification* within.

^z See Mr. *Boyle's* *pneumatical Experiments* to this purpose.

^a See this *Weather-glass* described, *Novum Organum*, Part II. *Aph.* 13. (38.)

Fire. No other Contrivance is requisite to this Purpose, than to leave a close hollow Space under the Altar, filled with Air; which being heated by the Fire, and consequently dilated, shall find no exit but thro' a Pipe rising along the Wall of the Altar; and having its Mouth bent down at last, so as to discharge upon the Altar. This upright Pipe was filled with Water; and had a belly in the middle, that it might contain the larger Quantity; and a Stop-cock at the bottom, to prevent the Water from falling thro'; which Stop-cock being turned, admitted the dilated Air to rise up, and drive out the Water ^b.

8. (6.) It was the Invention of *Fracaſtorius*, to recover Persons from apoplectic Fits, by applying a heated metalline Pan, at some distance, round the Patient's Head; in order to dilate, excite, and revive the Spirits stagnating, congeal'd, or block'd up by the Humors, in the Cells of the Brain. *A heated Warming-pan applied to the Head in Apoplexies.*

9. (7.) Butterflies, and the like Creatures, which lie for dead in the Winter, recover Motion and Life by being warmed before the Fire; or by the Rays of the Sun. And Persons in fainting Fits, are brought to themselves by taking, internally, such Liquors as are spirituous and heating, as well as by external Heat, Friction, and Motion. *Warmth recovering Life.*

10. (8.) *Water* opens, or expands itself, in the following manner. With the first Heat it emits a small and rarified Vapour; without any other visible Change in its Body. Upon continuance of the Heat, it does not rise in its whole Body, nor in small Bubbles, in the way of Froth; but ascends in larger and rarer Bubbles, and resolves itself into a copious Vapour; which, if not obstructed, checked, or condensed, mixes with the Air; being first visible, but afterwards diffusing itself, and becoming insensible. *Water how expanded by Heat.*

11. (9.) *Oil* opens itself thus. With the first Heat, certain little Drops ascend; or small Grains diffuse themselves thro' the Body of the Oil; and this with a small crackling Noise: in the mean time, no Bubbles play upon the Surface, as in Water; nor does the whole Body swell, or emit any considerable Exhalation. But, after some Continuance, the whole Body rises and dilates itself, very considerably; expanding, as it were, to double the Bulk: and going off in a very copious and thick Exhalation. This Exhalation, if it does not take Flame, at length mixes with the Air; as does the Vapour of Water. But Oil requires a greater degree of Heat to make it boil; and begins to boil much slower than Water ^c.

12. (10.) *Spirit of Wine* rarifies, or opens itself, rather like Water than Oil: for it boils up in large Bubbles, without Froth, or Elevation of the whole Body; but it expands and flies off with a much less degree of Heat, and with much greater Velocity, than Water. It partakes both of an aqueous and oily Nature; readily mixes with Air; and suddenly takes Flame. *Spirit of Wine.*

13.

^b Here add the modern Contrivance of making *Jet d' Eau*, and Fountains by the Spring of compressed Air.

^c Lead melts at the Bottom of Oil, before the Oil begins to boil.

Vinegar and Wine.

13. (11.) *Vinegar, Verjuice, and Wine*, open themselves differently in this respect, that *Vinegar* rises in smaller Bubbles, and more about the sides of the Vessel; but *Verjuice* and *Wine* in larger Bubbles, and more in the middle of the Vessel.

Unctuous Liquors.

14. (12.) In general, unctuous Liquors, as *Oil, Milk, Fat, &c.* rise and swell in their whole Body, at once; whilst ripe Juices, (and unripe ones still more) rise in larger Bubbles; but old and vapid Juices, in smaller.

Liquors in general.

15. (13.) 'Tis common for all Liquors, even *Oil* itself, before they boil, to throw, now and then, a few kind of half-Bubbles about the sides of the Vessel.

16. (14.) 'Tis likewise common for all Liquors to open themselves sooner, and to boil, and consume, in a small Quantity, than in a large one.

ADMONITION.

Experiments of the Rarification of Liquors, to be made in Glasses.

17. The Experiments about the opening of Liquors should be made in Glass Vessels; that the Motion in the Body of the Liquor may appear more visible; and upon little Furnaces with equal degrees of Heat, that their Differences may be the more exactly noted. The Fire also must be gentle; because when vehement, it hurries on and confounds the Actions of Bodies^d.

HISTORY.

Bodies fluid with Heat.

18. (1.) There are numerous Bodies, not of a liquid, but solid Consistence, that by Heat acquire a degree of Fluidity, so long as the Heat continues to agitate and expand them; such are *Wax, Suet, Butter, Pitch, Rosin, Gums, Sugar, Honey, Lead, Gold, Silver, Brass, Copper, &c.* tho they require not only very different degrees of Heat to open them; but also different Modifications of the Fire and Flame. For some Metals melt over a common Fire; as *Lead*: others require a Fire animated by Bellows; as *Gold* and *Silver*; and others again, the admixture of certain Matters. So *Steel* does not melt without the Addition of some sulphureous Body.

19. (2.) But if the Fire be continued brisk and strong, all these Substances not only open by Colliquation; but also undergo a second Opening, as that of Volatility, and Waste, except *Gold* alone. *Quicksilver*, which is a natural Fluid, begins with this second kind of Opening; and is easily volatilized. But with regard to *Gold*, it still remains a Question, whether it can be rendered volatile, pneumatical, or *potable*, as they call it; that is, not soluble, as by means of *Aqua regia*, which is a common and obvious Operation; but digestible, or alterable by the human Stomach. And the genuine Criterion of this Change is not, that the *Gold* becomes volatile in the Fire;

^d A complete Table of this kind is still wanting; and should be derived from express chemical Experiments.

Fire; but so subtle and attenuated as to be irreducible to Metal again ^c.

20. (3.) Let farther Enquiry be made about Glafs and vitrified Bodies, *Glafs, whether they are consumable by Fire, and convertible into pneumatical Bodies: for Glafs is accounted a fixed and juiceless Body; and Vitrification the Destruction of Metals.* *whether consumable.*

21. (4.) All Bodies capable of Fusion, begin the Process of it from the lowest degree of Opening; viz. Softness, and Suppleness, before they melt and run; such as Wax, Gums, Metals, Glafs, &c. *The first Process of Fusion.*

22. (5.) But Iron ^z and Steel, when perfectly purified and unmixed, bear a simple Fire, without proceeding farther than to a degree of Softness; so as to become malleable and flexible, but not fusible, thereby. *Steel and Iron do not fuse.*

23. (6.) Iron and Glafs, when opened to the above-mentioned degree of Softness, seem to be dilated in their included Spirit; whence their tangible Parts are so wrought, as to lay aside their Hardness, and Resistance; tho the whole Body is not, at the same time, visibly dilated, or swelled. But upon an exact Enquiry, there will be found a certain invisible Tumefaction, and Agitation of Parts therein; tho this be restrain'd by their close and compact Nature. For if thoroughly ignited Glafs be laid upon a Stone-Table, or other the like Body, tho well heated before hand; the Glafs will break, thro' the Hardness of the Stone resisting its secret Tumefaction: and therefore, in taking Glafs out of the Melting-pot, in order to blow it, they usually roll it upon some certain Powder, or soft Sand; which may gently give way, and not oppose this Tumefaction in the Parts of the Glafs. *Glafs how dilated by Heat.*

24. (7.) Bullets likewise shot from a Gun, after their projectile Motion entirely ceases, so as that, to the Eye, they shall seem perfectly at rest; yet a great shuddering Motion, or Pulsation, will be found, in their small Parts, for a long while after: insomuch, that if any proper matter be laid upon them, it will thence receive and manifest a considerable Force; and this proceeds not so much from the burning Heat, as from the Tremor of Percussion. *Shuddering Motion in Bullets.*

25. (8.) Rods of Wood being fresh gathered, and kept turning in hot Embers, acquire a Softness; whence they may be bent at pleasure. And this Experiment should be tried in old Rods and Canes ^b. *Wood softened by Heat.*

26. (9.) Combustible Bodies open so, as by Fire, first to emit a Fume; then to take Flame; and lastly, fall into Ashes. *Combustible Bodies how relaxed.*

27. (10.) Bodies which contain an aqueous Moisture, that refuses the Flame, and yet are close and compact; as Bay-Leaves, Salts, &c. open by the Fire in such a manner, that the aqueous and crude Spirit they contain, being dilated by the Heat, bursts out with a crackling Noise, before they take Flame: but if a Body at once emits a Flatulency, and takes Flame, a violent Tumult, and a powerful Dilatation ensues; that Flatulency, like

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Bellows

^c This Point seems not hitherto settled to general Satisfaction.

^f But improperly, as Metals are easily recoverable from their Glasses.

^z Viz. hammer'd Iron.

^b It has even been tried in large Timbers for Ship building, with considerable Success.

Bellows on the inside of the Body, blowing and expanding the Flame every way, as in Gunpowder.

Bread. 28. (11.) Bread swells or rises somewhat in the Oven; tho it loses a little of its weight. And on the top of the Loaf sometimes gathers a kind of crusty Bubble, or Bladder; so that there remains a Cavity fill'd with Air, between the Pellicule of the Crust, and the second Surface of the Loaf.

Roasted Flesh. 29. (12.) Roasted Flesh also acquires a degree of Tumefaction; especially when the outward Skin is left upon it: as we see in roasted Pigs, &c.

Fruits. 30. (13.) But roasted Fruits sometimes leap out of the Fire; as Chestnuts: sometimes burst their Skin, and spirt out their Pulp; as Apples: and if scorched by the Fire, they acquire a burnt or scaly Crust; and, as in the abovemention'd Case of Bread, leave a Cavity between that Crust and the Flesh of the Fruit. The same thing likewise happens in Eggs.

Baked Meats. 31. (14.) But if the Heat be slow, and without manifest Fire, and there be also no ready vent for the Vapour; as when Pears are roasted in the warm Ashes; and still more remarkably when the Bodies to be treated are put into Pots, and then buried under the Ashes, or set in the Oven, &c. in these Cases the Tumefaction or Dilatation is repell'd, by the Heat, and turn'd back upon itself; whence ensues a Condensation, as in Distillation; and the Body is more moistened, and, in a manner drowned with its own Juice: as appears in Pies, Tarts, and other Works of Pastry and the Oven.

Dry Bodies. 34. (15.) But dry Bodies, if the Flame be suffocated and find no easy exit, become rarified, hollow, and porous; as we see in Charcoal, and the Pumice-Stones discharged from burning Mountains.

SECT. V.

Of DILATATIONS by external HEAT, and DISTILLATIONS.

Two kinds of Expansion by Distillation. 1. **T**HERE are two kinds of Dilatation, Opening, or Attenuation, of Bodies in Distillations; the one in Passage, when the Body is turn'd into Vapour or Fume, which is afterwards restored; the other in the Body so restored; which is always more rarified, more subtle and expanded than the crude Body from whence it was distill'd: as Rose-water, for Example, is more rarified and light, than the Juice of Roses.

The Action of Distillation. 2. All Distillation is perform'd by a kind of Flux and Reflux, or alternate Rarification and Condensation; the one raising the Vapour, or rendering the Body pneumatical; and the other striking it back, or restoring it to a tangible state.

The Dilatation spurious in Distillation. 3. The Actions of Dilatation and Condensation, are not pure in the Case of Distillations; but the Separation of heterogeneous Parts intervenes: which is the intentional Action with regard to Practice; whereby the purer Juices, the Phlegm,

Phlegm, the Oil, the fine Parts, and the gross Parts of Bodies are separated from each other.

4. Under Distillations 'tis proper to enquire into, and determine, the degrees and diversities of Heats; as that of Coals, a hot Oven, that of Baths, that of Water, Ashes, Sand, &c. that of the Sun, Horse-dung, Fire left to itself, Fire animated by Bellows, Fire confin'd and reverberated, Heat ascending, Heat descending, and the like; all which have a remarkable Efficacy in the opening of Bodies; and particularly in the complicate Actions of Dilatation and Contraction. For these Heats seem by no means to resemble the Heat of the Sun, and celestial Bodies; neither in gentleness, softness, temperature, continuance, refraction, modification by intermediate Bodies; nor in ebbing and flowing, with the remarkable inequality of Day and Night. But all these particulars shou'd be diligently examin'd, under the general Titles of *Heat* and *Cold*; with their subordinate Divisions ^{*Different Heats.*} ^{*The Process of Distillation.*}

5. Distillations, and the Dilatations they cause, are perform'd in a close Vessel; where the Body to be distill'd, the Vapours it affords, and the Air, are shut up together: for in the common Stills and Alembics, the external Air is not excluded from entering, in some degree, the Pipe of the Still-head, or Nose of the *Worm*. But in Retorts, where a stronger Heat is required, the external Air has no Entrance; the Mouth of the Receiver being join'd by a Luting to the Neck of the Retort; so that the whole Process of Rarification and Condensation is perform'd within. But if the Body be full of a vigorous Spirit, as Nitre or Vitriol, it requires a capacious Receiver; that the Vapours may freely play about therein, without bursting the Glass.

P R E C E P T S.

6. (1.) But tho Distillations are perform'd, as it were in a close Cell; yet there is still Space enough allowed for some parts of the Body to expand into Vapour, and other Parts to subside in Fæces; and again, for the Vapours to wind and roll about, restore themselves, and, when of different Natures, to separate one from another. The following *Precept*, therefore, is of the utmost importance; as it may advance a Method of putting Nature to the Scrutiny, and producing new Transformations: for the Fire of the Chemists and Physicians, tho it has produced many useful Things; yet does not, perhaps, obtain the more genuine Virtues, and Properties of Heat, by reason of the Distractions and Separations of the Parts, which constantly happen in their Operations. The Sum of our *Precept*, comes to this, that all Separation, and all Flux and Reflux of Rarification and Condensation, be totally prohibited; and that the Heat be spent entirely within the Body itself, and its Cavities. Such a Method may possibly hold the *Proteus* Matter, bound and manacled; and compel it to try all its Shapes and

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* See Mr. Boyle's History of Cold; and the Chapter of Fire in Dr. Boerhaave's Chemistry.

Conversions, in order to free and clear itself. Numerous Instances occur to us, with regard to this Affair ; and others may be discovered : but we will here propose only an easy Example or two, the more fully to express our meaning.

A new Digestor applied ; by an Example, in Wood.

7. (2.) Having provided a cubical Vessel of Iron, the sides whereof are very strong and thick ; fit a Cube of Wood exactly to it, so as perfectly to fill the Cavity : then, in the securest manner, fix and lute on a strong Cover of the same Metal, so as not to give the least vent ; but remain capable of bearing the Heat. Now place the Vessel in the Fire, and there continue it for some Hours ; afterwards take off the Cover, and examine what Change the Wood has suffered. It shou'd seem, that as the Wood in this Case, cou'd neither flame nor emit a Fume, so as to discharge any of its pneumatical or moist Parts ; the Body of the Wood must either be converted into a kind of Amalgam ; or resolved into Air ; that is, a truly pneumatical Body ; leaving at the bottom, certain feculent Parts, grosser than Ashes ; and some Incrustation on the sides of the Vessel.

Water in Confinement.

8. (3.) Let Trial also be made of a quantity of pure Water, that shall perfectly fill a like kind of Iron-Vessel : but here the Fire shou'd be more gentle ; and the Operation of longer Continuance. The Vessel also might be removed from the Fire at certain Hours ; and afterwards put on again : and this for several times. We make Choice of pure Water for this Experiment, because Water is a simple Body, without Colour, Smell, Taste, or other remarkable Qualities. And, therefore, if by a mild and gentle Heat, an interchange of heating and cooling, and a prevention of all Evaporation, the Spirit of the Water shall not be lost, but still be wrought upon, and become attenuated by this kind of Heat, so as to turn itself upon the grosser Parts of the Water, and digest and change them into a new Texture and Arrangement, of greater Simplicity and Uniformity ; the Water thus acquiring either a different Colour, Smell, Taste, a degree of Oiliness, or any other considerable Alteration, like what we find in compound Bodies ; doubtless it wou'd prove a great Acquisition, and open a way to numerous Particulars of moment ^m.

And made general.

9. (4.) In this Method of *close Distillation* ; that is, where no Space is allow'd for Evaporation ; any one may easily invent many other Experiments. And this we are certain of, that a suitable Heat operating upon a Body, without separating or consuming its Parts, may produce wonderful Effects and Changes of Structure ⁿ.

10. (5.) We

¹ The Experiment seems to have never been tried ; on account, perhaps, of the Danger that may be apprehended from the bursting of the Vessel. But any Inconveniences of this kind might be prevented by an Artist.

^m Because it wou'd then afford a practical Instance of the Transmutability of Bodies. See the *Sylva Sylvarum* passim.

ⁿ It shou'd seem that great Light may be derived to Philosophy from this kind of *Digestor*, as there has been from the Air-Pump, Telescope, &c. See Dr. Papin's Account of his Digestor ; and let the Contrivance be improved, transfer'd, and varied ; and a proper Set of *Leading Experiments* be tried both upon this, and other kinds of *Digestors*.

10. (5.) We might add, as an *Appendix* to this *Precept*, that some Method shou'd be discovered (which certainly is not difficult) whereby Heat may operate, not only in a close, but in a tensile, or extendible Vessel: which is the Case in a every natural Matrix, whether of Vegetables or Animals. For such an Operation extends to many Things, not performable by simple Confinement. This Contrivance does not regard the *Pygmy of Paracelsus*, or any such monstrous Trifles; but Things of Weight and Solidity. For Example, *close Distillation* can never make a total Conversion of Water into Oil; because Oil possesses more Space than Water: but if the Operation were performed in an extendible Body; perhaps this Transformation might be effected: which wou'd be a Thing of prodigious Use; as all Alimentation principally depends upon Fat °.

Operations to be perform'd in extendible Vessels.

11. (6.) 'Twere a proper and very useful Thing, sometimes in Distillations to compel Nature to an Account; and take a just estimate of the quantity lost in the Operation: that is, of the quantity grown pneumatical; and again of the remaining Part, whether fix'd or restored in the Body. This may be done by first weighing the Body to be distill'd, and the Vessels wherein the Operation is to be perform'd; and after the Operation is over, weighing the distill'd Liquor, the Fæces, and lastly the Vessels again: by which means may be learn'd what proportion was restored; what proportion remain'd in the Fæces; and what adhered to the Vessels: and the deficiency of the three several Weights, compared with the Weight of the whole Body, will shew what Proportion was rendered pneumatical °.

The Matters lost in Distillations so be estimated.

S E C T. VI.

Of the DILATATIONS and RELAXATIONS of Bodies by the Remission of Cold.

T R A N S I T I O N.

1. **W**E proceed from the Dilatations and Rarifications caused by actual Heat, to the Dilatations and Relaxations produced by the Remission of violent and intense Cold: and this Remission shou'd be esteem'd a comparative degree of Heat.

2. (1.) Bodies froze by violent Cold; but not so far as, by the continuance of the Cold, to remain fix'd in their Condensation; open and restore themselves without manifest Heat; and barely upon a remission of Cold: as in Ice, Hail, Snow, &c. but they do this much quicker upon the application of manifest Heat.

Bodies froze and thaw'd.

3. (2.) But

° See the *Sylva Sylvarum* passim.

¶ Something of this kind has been done by M. Lemery in his *Course of Chemistry*; but Mr. Hales in his *Vegetable Statics*, has prosecuted the Thing with great Exactness; and more directly to the present purpose.

Fruits.

3. (2.) But the more delicate Substances, whose Vigour consists in a subtile native Spirit; as Apples, Pears, Pomegranats and the like; have their Spirit suffocated by Congelation; so as not again to recover their pristine Vigour upon Thawing^a.

Liquors.

4. (3.) Wine likewise, and Malt Liquors, grow flat to the Taste, and lose of their Vigour upon freezing: Yet they revive, relax, and as it were ferment again after thawing, when the Weather becomes warm, and the Wind Southerly^r.

S E C T. VII.

Of the DILATATION and RELAXATION of Bodies by potential Heat; or the auxiliary Spirits of other Bodies.

T R A N S I T I O N.

Instances of potential Heats to be derived from medicinal History.

1. **A**S to the Subject of *potential Heats*, 'tis proper to consult the medicinal Tables of *secondary Qualities*; which exhibit the Things that operate by *Dilatation*, upon the human Body: and they are in general such as these.

V I Z.

Medicines acting by Dilatation.

2. (1.) *Cardiacs*, which dilate the Spirits oppress'd.
- (2.) *Abstergents*, which strengthen the expulsive Faculties.
- (3.) *Aperients*, with regard to the Orifices of the Veins and Vessels.
- (4.) *Aperients*, with regard to the Pores and Passages of the Parts.
- (5.) *Digestives*, which ripen at the same time.
- (6.) *Digestives*, which discuss at the same time; and,
- (7.) *Caustics*, which burn and consume the Flesh.

Their manner of Action.

3. These Things have their Effect principally by dilating the Spirits, Humours, Juices and the Substance of the Body, by means of auxiliary Spirits; and again by a stimulating Virtue which such Medicines have in contact with the Parts of the Body, whether used internally or externally.

S P E C U L A T I O N.

The Spirits more sensible of heat than Air.

4. It appears from the Weather-glass what an exquisite Sense, or Perception, the common Air has of Heat and Cold; as immediately shewing the most

^a Unless thawed by being put into cold Water.

^r The Particels wanting in this Section, may in great Measure be derived from Mr. Boyle's *Experimental History of Cold*.

most subtile Differences and Degrees thereof. And we judge, that the Perception of the Spirits in Animals, as to Cold and Heat, is much more acute and subtile : only the Air is a pure and genuine pneumatic Body, that has no tangible Parts mix'd among it ; and the Perception of the Spirits is dull'd and blunted by the tangible Body in which they are detain'd. But notwithstanding this Impediment, the Spirits of living Creatures seem more delicate, or sensible, than the Air itself : for it has not hitherto appeared, that potential Heat can cause a Dilatation of the Air ; whereas it certainly has that Effect upon the Spirits contain'd in the Parts of Animals : which is manifest from the secondary Qualities of Medicines. But of this let farther Enquiry be made ; according to the following *Precept*.

P R E C E P T.

1. Take two Weather-glasses, of the same size ; fill the one with Water, and the other with rectified Spirit of Wine ; heat the Glasses in such a manner, that both the Water and the Spirit may stand at the same height ; then place them together, leave them a time, and observe if the Water stand higher than the Spirit : for if it does, 'tis plain that the potential Heat of the Spirit of Wine expands the Air, so as to depress the Spirit ^{*Whether the potential Heat of Spirit may rarify.*}.

2. It might be very useful, sometimes to try and exercise the Operations of the secondary medicinal Qualities in lifeless Bodies. For altho no Effect cou'd be expected from most of them ; as a living Spirit is absolutely required to actuate them, on account of the subtilty of the Operation ; yet others of them wou'd doubtless have an Operation upon some inanimate Bodies. Thus, we see what Effect Salt has upon Flesh, Spices upon dead Carcasses, Rennet upon Milk, Leaven upon Bread, &c. The diligence therefore of Physicians, as to their secondary Qualities, may, if judiciously considered and transfer'd, serve in performing numerous other Operations : always supposing that a stronger virtue is required to operate upon a dead Body than a live one ^{*That secondary Qualities may act upon inanimate Bodies.*}.

S E C T.

¹ The difference may proceed from the Spirit of Wine being more rarifiable by the warmth of the external Air, than Water ; but whether Rarification be the Form of Heat is not hitherto satisfactorily determin'd. See the *Novum Organum*, Part II. *Aph.* 12, &c.

² The proper Use seems not hitherto made of this *Precept*.

S E C T. VIII.

*The History of DILATATION in Bodies, by a Release-
ment of their Spirit.*

T R A N S I T I O N.

*The Spirits of
Bodies how re-
leased.*

I. **W**E come next to the Dilatations of Bodies made by a Release-ment of their Spirits, upon breaking the Prison of the grosser Parts, which closely detain'd them, so that they cou'd not dilate : for in Bodies which have a compact closeness, and remain strongly bound together in their wholes, the Spirits cannot perform their Office of dilating ; unless there be first a Solution of Continuity in the grosser Parts, made either by corrosive Liquors, with or without the assistance of Heat : and this appears in the opening and dissolving of Metals.

*Ductility of
Gold.*

2. (1.) A Penny-weight of pure *Gold* may be reduced, by the Hammer, into thin Plates ; so as to be readily torn betwixt the Fingers.

*Gold dissolved
in Aqua re-
gia.*

3. (2.) If the Gold be now put into a Glass, with four times its quantity of *Aqua regia*, and the Glass be set over a very soft and gentle Fire ; there will soon appear to arise therein certain little Grains, which, after a small Continuance, diffuse themselves and incorporate with the Liquor ; so as to render it bright and shining ; as if tinged with Saffron. But the Gold, in the Proportions here set down, dissolves only to a third ; for the Menstruum will imbibe no more : so that if the whole Penny-weight of Gold were to be dissolved, the saturated Menstruum must be poured off ; and again four Penny-weight of *Aqua regia* poured on ; and so for the third time. This Dissolution proceeds calmly, and slowly, in a moderate Heat, without Fumes, and without heating the Glass, more than what the Fire occasions.

*Quicksilver
dissolv'd in
Aqua fortis.*

4. (3.) To a quantity of crude *Quicksilver*, put into a Glass, add twice its weight of *Aqua fortis* ; and without setting the Vessel to the Fire, there will presently rise up something like a very fine Powder, in the Body of the Liquor ; and in the space of an Hour, without Fire, without Fumes, and without Tumult, the Mixture will appear a clear uniform Liquor.

Lead.

5. (4.) Put a Penny-weight of thin plated *Lead* to nine Penny-weight of *Aqua fortis* : the Lead will not here incorporate so well as the other Metals ; but the Menstruum throws down the greater part of the Lead, in form of a *Calx*, to the bottom ; the Liquor above, remaining somewhat turbid, tho tending to transparency.

Silver.

6. (5.) To a Penny-weight of plated *Silver*, add four Penny-weight of *Aqua fortis* ; set them in a gentle Heat : and the Silver will rise within the Body of the Liquor, like small Sand, or Bubbles, a little larger than those of Gold ; and incorporate with the Menstruum, and turn with it into a thin, white, and as it were milky Liquor : but after standing and cooling for a while,
icy

icy Plates appear to shoot in the Body of it, proceeding from the mixture of the Metal and the Menstruum: but when, after a longer stay, the Separation is totally made, the Liquor becomes clear and crystalline; throwing the icy Plates to the bottom. The Menstruum here sustains the full weight of the Metal; as in Gold; and the Dissolution is made almost with the like Heat; and does not increase it by Motion, any more than in the case of Gold.

7. (6.) Six Penny-weight of *Aqua fortis* being put to one Penny-weight *Copper*, of *Copper-Filings*, and set in a Sand-heat; the Copper rises in larger Grains, or Bubbles, than Silver; and soon after incorporates with the Menstruum into a blue turbid Liquor; but upon standing, it brightens up, like the Sky, into a shining beautiful Blue; throwing down the Fæces, in form of Powder, to the bottom; which Fæces, however, are diminish'd in time, and ascend and incorporate with the rest: and thus six Penny-weight of *Aqua fortis* dissolves one Penny-weight of Copper, entirely; so that the Menstruum here suffers itself to be charged with twice the weight it did in the case of Gold and Silver. But the Solution of Copper conceives a manifest Heat, by the internal Conflict, even before it is applied to the Fire.

8. (7.) Three Penny-weight of *Aqua fortis* being added to one Penny-*Tin*, weight of *Tin-Filings*, the whole Metal is turn'd into a Body like Cream or Curds, which does not readily clarify itself; but conceives a manifest Heat without Fire.

9. (8.) Nine Penny-weight of *Aqua fortis* being poured upon one of *Iron*, *Iron-Filings*, the Metal, without Heat, rises up in large Bubbles; not only within the Body of the Liquor, but above it; so as to boil out at the mouth of the Glass: at the same time emitting a copious, dense and Saffron-coloured Fume; with a violent Conflict, and a great degree of Heat, insufferable to the Hand.

ADMONITION.

10. No doubt but the different Properties of different Menstruums, and the manner of applying the Fire or Heat, may cause some Alterations in the form wherein Metals open themselves. *Metals open differently in different Heats.*

P R E C E P T.

11. (1.) Observation shou'd be made, what kind of Dilatation happens in the opening of Metals; as whether it be like that of Leaf-Gold, which is a spurious Rarification, wherein the Body is dilated rather in Place than Substance, after the manner of Powders; or whether the Body of the Metal be actually dilated in Substance. This may be determined by the following Experiment. Take an exact weight and measure of Quicksilver, and so of *Aqua fortis*, after the manner of our *first Table*; then make a Solution thereof, and weigh it in the two Vessels, wherein the Quicksilver and *Aqua fortis* were

The History of CONDENSATION,

were separately weigh'd ; and observe whether the weight and measure of the Compound exactly answer to the weight and measure of the same Bodies, when separate. We make choice of Quicksilver for this Experiment, because, as it dissolves without Fire, there is the less Suspicion of waste.

Whether metallic Solutions may support Metals.

12. (2.) It shou'd be observed, whether a Solution of Quicksilver may not support the heaviest Stones, or even Tin, so as to keep them floating. This might be collected from knowing the Proportions of their specific Gravities. And let not this be suspected as tending to Miracle and Imposture ; but only to the Investigation of the Nature of Mixture.

OBSERVATION.

Metals dissolving like Sand.

13. 'Tis worth observing, that all Metals, tho remarkably heavier than the Menstruums in which they dissolve, yet ascend in the form of Sand or Bubbles, during the first act of Solution : and this is the more considerable where they do the same without Fire, as in the Case of Quicksilver.

SPECULATION.

Intimation of the Cause of Solution.

14. The Tumult happening among the Parts of the Bodies in the Dissolution, is the Cause that the Metals ascend in this manner : for Bodies are somewhat impell'd by a local Motion in all violent Corrosion ; as plainly appears from little gravelly Stones, which being put into strong Vinegar, on the sides of a Porringer, that they may easily slide ; continue moving, or as it were, swimming by Fits, like little Fish. There is also a kind of Stone, or Fossil, which, when put into Vinegar, moves and runs up and down therein, with a restless Motion. But the Bodies that mix without this Tumult, do not perhaps readily ascend, without shaking : So Sugar dissolving at the bottom of Water, does not dulcify at the top ; nor Saffron, in like manner, tinge, without Commotion and Agitation.

S E C T.

* Some attempt of this kind was made by Dr. Hook, and Dr. Grew ; but the matter, perhaps, has not been duly prosecuted.

u See Dr. Grew's Discourse concerning the Nature, Causes and Power of Mixture.

v See Mr. Boyle upon Fluidity and Firmness.

S E C T. IX.

The History of DILATATION, upon the meeting and uniting of Bodies related.

T R A N S I T I O N.

1. **W**E must next come to another kind of Dilatation, commonly call'd by the Name of *Dissolution*, in some Cases. The Dilatation of corresponding Bodies explain'd. This happens where Bodies run into the Embraces of one another, and, if possible, open themselves, so as to receive each other internally. But this Relaxation does not happen with any Tumult, or by the Penetration of the entering Body, as Menstruums penetrate Metals; but calmly, and by a Relaxation of the receiving Body.

2. (1.) Sugar and some Gums, viz. Gum Tragacanth, Gum Arabic, &c. Instanced in being put into Water, resolve; as willingly relaxing their Parts, like a Sugar and Water. being put into Water, resolve; as willingly relaxing their Parts, like a Sponge, to receive the Liquor in amongst them.

3. (2.) Paper, Fur, Wool, and the like porous Bodies, being plunged in aqueous Liquors, or otherwise moisten'd, open themselves, so as to become more soft, yielding, separable, and as it were putrefied. Paper, &c.

4. (3.) Sudden Joy remarkably dilates the Spirits of Men; as upon the hearing of good News, seeing the Object desired, &c. and tho there be here no Contact of Bodies; but only an Act of the Imagination; yet this Act is sometimes so powerful, as to endanger sudden Fainting, or even Death itself. And something of the like kind happens when the Imagination is earnest upon venereal Pleasures. Dilatation upon J y.

P R E C E P T.

5. All endeavours shou'd be used, to discover peculiar Menstruums for each particular Substance; since, in all probability, there are Liquors, and soft pappy Bodies, that have such a Sympathy, or Correspondence, with particular Matters, that upon the Application thereof they will readily relax their Parts, willingly imbibe the others, and thus become mollified and renewed in their own Juices. And this regards one of the Capital Things in all Nature; viz. the refreshing, and recruiting the most radical and essential Moisture of Bodies from without; such as Flesh, Bone, Membranes*, Wood, &c. So likewise there is a Sympathy, or Correspondence, in the Bodies which operate by Divulsion, and Penetration: for *Aqua fortis* does not dissolve Gold, nor the common *Aqua regia* Silver †.

A a a a 2

S E C T.

* See the *History of Life and Death*, passim.

† Upon finding out these *Sympathies*, or *Relations*, betwixt Bodies, and the Menstruums they indicate, the perfection of *Chemistry*, and a large part of *Natural Philosophy*, seems to depend.

S E C T. X.

The History of DILATATION by ASSIMILATION, or the Conversion of a grosser Matter to such as is more subtile.

T R A N S I T I O N.

Dilatation by Assimilation, how produced.

1. **W**E next pass on to the *Dilatation by Assimilation, or Conversion*; wherein the over-ruling, and more active, Body subdues the other that is more obsequious and passive; so as actually to turn that into itself, and multiply and renew its own Substance thereon: but if the Body thus assimilating be more subtile and rarified than the Body assimilated, this *Assimilation* of necessity produces *Dilatation*.

Air assimilates Moisture.

2. (1.) Air licks up the humidity of the Earth, preys upon it, and converts it into itself; but chiefly when in Commotion, as in the Case of Winds ¹.

3. (2.) The Process of Desiccation in Woods, Plants, &c. that are not very hard, or stubborn, turns upon the Depredation of the Air; which draws out, sucks up, and turns to its own Substance, the Spirit of the Body: whence this Process proceeds but slowly in fat, and oily Bodies; because their Spirit, and Moisture, are not so nearly of the same Substance with the Air.

Spirits assimilate a grosser Matter.

4. (3.) The Spirits of tangible Bodies feed and prey upon the grosser Parts of the Body that includes them: for the Spirits which approach nearest to Air, obey its Call, and go forth suddenly; but those which reside deeper in the Body, prey upon the more internal Parts that lye contiguous, beget new Spirits thereon, join these to themselves, and at length fly off together: whence such Bodies by Age, or long lying, diminish in their weight; which cou'd not possibly happen, unless some tangible Part were gradually converted into an untangible or pneumatical one; for Spirit once formed in a Body, has no longer any Gravity in that Body, but rather helps to lighten it ².

Tumours diseased by Perspiration.

5. (4.) Many Tumours in the Bodies of Animals are diseased by *insensible Perspiration*, without Suppuration; and render'd perfectly pneumatical, subtile, and perspirable.

6. (5.) Fla-

¹ See the *History of Winds*, passim.

² If this be meant of specific Gravity; or supposing the Body weigh'd in Air; it may be readily allowed: but if meant of absolute Gravity, or supposing the Body weigh'd in a *Vacuum*; it will perhaps require more exact Experiments to determine it.

6. (5.) Flatulent Eatables produce Windiness in the Body ; their Juices being converted into Flatus, and Air ; which escape by Eructation and otherwise : tho sometimes not without extending, and griping, the internal Parts. The like also sometimes happens from the most approved Aliment, by reason of a weakness in the digestive Faculties. *Wind generated in the Body.*

7. (6.) In every Body requiring Aliment, when the Parts nourished are finer or more subtle than the Nourishment ; Alimentation must necessarily cause a Dilatation. Thus the Spirits and Juices of Animals are lighter than the Solids, or Liquids, that nourish and supply them. *Alimentation causes a Dilatation.*

8. (7.) Of all Openings, Dilatations and Expansions, the greatest in proportion to the Body before and after the Dilatation, the quickest, and of least Duration, is that of oily and inflammable Bodies into Flame ; which seems to be done copiously, and at once, without stop or degree. And here the Succession of the Flame is plainly a kind of Assimilation ; whilst the Flame multiplies itself upon its Fewel. *Oil expanded into Flame.*

9. (8.) But the most powerful Thing of this kind, not with regard to the suddenness of first catching Flame (for Brimstone, Camphire, or Petreol catch Flame sooner than Gunpowder) but with regard to the Succession of the Flame once caught ; and overcoming all Resistance ; is that mixed Expansion beforementioned, of Gunpowder into Flame and Air ; as in the firing of Cannon ; the blowing up of Mines, &c. *Gunpowder into Flame and Air.*

10. (9.) The Chemists observe a very violent Expansion of Quicksilver by the Fire, and also of a preparation of Gold ; so as to explode in a dangerous manner ; and give a report like that of a Gun^a. *Quicksilver and Gold expanded.*

S E C T. XI.

Of DILATATIONS, or DISTRACTIONS, by external Force.

T R A N S I T I O N.

1. **W**E shou'd next proceed to those Dilatations, Distractions, or Divulsions, that proceed not from any Appetite in the Body dilated ; but from the Violence of external Bodies, which, prevailing with their Motions, lay the Body under a Necessity of being dilated, or stretched. This Enquiry, however, belongs to the Title of free Motion ; but, as in the former Cases, so we shall here also add somewhat upon this Head. The Motion we speak of is generally of two kinds ; the one being a Motion of *Distract*ion, from external Force ; and the other a Motion of *Contract*ion, or Restitution, proceeding from the Motion proper to the Body. *The Motion of Dilatation double.*

^a Viz. the *Aurum Fulminans*.

dy. This latter Motion, tho it belong to Condensation, is yet so join'd with the former, that it may commodiously be treated in this place.

Bent Rods.

2. (1.) Rods of Wood, and the like, suffer some degree of forcible Bending; which draws the external Parts asunder in the bent place; and compresses the internal Parts. If the bending Force be soon after remitted; the Rod flies back and restores itself: but if the Rod be long detain'd in that curved Position, it fixes there, and starts back no more.

Watch-Springs.

3. (2.) The Case is the same in Watch-Springs; where the piece of coiled Steel has a constant and gradual endeavour to unwrap or restore itself.

Cloth.

4. (3.) Cloth, and the like Substances consisting of Threads, receive a great degree of Extension; and restore themselves, if soon let go; but not if they have remain'd long stretch'd, or tentered.

The Flesh in Cupping-Glasses.

5. (4.) The Flesh which rises upon the application of a Cupping-Glass, is not a Tumor; but a violent extension of the entire Flesh, by Attraction ^b.

The Rarefaction of the Air.

6. (5.) The following Experiment may serve to discover what degree of Rarefaction the Air is capable of. Take a Glass-Egg, with a small Hole in it; suck out the Air as much as possible; then immediately close the Orifice with the Finger; plunge the Egg, thus stopp'd, under Water, and now the Finger being removed, the Egg will draw in as much Water; as there was Air sucked out: so as that the remaining Air will recover its former Expansion, from which it was forcibly drawn and extended ^c. And, as I remember, the Egg drew in about a tenth Part of its own content of Water. I likewise left a Glass-Egg thus evacuated, and stopp'd up with Wax, a whole Day, to try if dilated Air might be fix'd by time; so as no longer to restore itself, like Wood or Cloth: but when the Wax was removed, the Water entered in as before; and even when unstop'd in the open Air, new Air enter'd at the Orifice, with a hissing Noise. But the time was here too short for an accurate Experiment ^d.

Of Water.

7. (6.) What degree of Rarefaction Water is capable of, may perhaps be thus discovered. Take a pair of Bellows, and draw up as much Water with them as may fill their Cavity; tho without raising the Bellows to their height, or but, as it were, half way. Then stop up the Bellows; and still continue to raise them by degrees; to see how far the Water received will suffer itself to be dilated: or otherwise, draw up Water by a Pipe, or Syringe; then close the Orifice; and gradually raise the Embolus, or Sucker, still higher ^e.

S P E-

^b See above, *Sett.* IV. 4.

^c Mr. Boyle has several apposite Experiments to this purpose.

^d This Experiment has been prosecuted by Mr. Boyle, Mr. Hawksbee, and others, by means of the *Condenser*, an Engine, which is the Converse of the *Air-Pump*. But it, perhaps, deserves to be carried still farther; by means of a stronger *Condenser* than the common; a greater condensing Power than that of a Syringe, work'd by human Strength; a much longer time of Rest being also allow'd.

^e This Experiment may perhaps be better tried in the exhausted Receiver of the *Air-Pump*; by including a spherical Glass of Water therein; with a long and slender Neck: for when the

SPECULATION.

8. We suspect that the Spirit of Water ^f suffers some Distraction in Congelation; tho this seems a very subtle Affair. But first, 'tis certain, that in all baking or burning, as in the baking of Bread, the burning of Brick, &c. a large proportion of the pneumatical part of the Body flies off, and exhales: whence, of necessity, the grosser Parts contract themselves, in some measure; by the *Motion of Connexion* ^g: for when the Spirit is gone off, and no other Body easily enters to possess the place deserted by the Spirit, the Parts come closer together, to prevent a *Vacuum*, as they phrase it; whence proceeds Hardness and a Contraction of the Body. So on the contrary, it shou'd seem that the Spirits of Bodies are drawn asunder by freezing; for the grosser Parts are contracted by Cold; so that there is left some space unoccupied within the Cells of the Body: whence it follows, that if no other Body succeed, the inherent Spirit must be stretched or distracted, by the *Motion of Connexion*, as much as the grosser Parts are contracted. And this appears to be the Case in Ice; the Body whereof is full of Cracks and Blebs, and somewhat swelled; whilst the Ice itself, notwithstanding the remarkable Contraction of its Parts, is in its Whole, specifically lighter than Water: which may, perhaps, be justly attributed to the Dilatation of its pneumatical Parts ^h.

Contraction and Congelation explain'd.

SECT. XII.

Of DILATATIONS by Diffusion, or Spreading.

TRANSITION.

1. **W**E come next to the *Dilatations by Diffusion*, when a Body heap'd up and press'd together, is spread out into a Plane or Flat. But this kind of Dilatations is to be accounted spurious; as being made, not in the Substance of the Body, but in the position of its Parts: for the Body here remains in the same Density of Substance, only acquires a larger Figure in Surface, and a less in Solidity.

Dilatation by Diffusion, spurious.

2. (1.) Gold

the pressure of the Atmosphere is taken off, the Water will swell and rise visibly in the Neck of the Glafs. Or it might be proper to try how far Water expands by a boiling Heat; and how far when converted into Vapours. For all which let Mr. Boyle, and farther Experience be consulted.

^f That Water has a Spirit, see confirm'd and illustrated in Dr. Hoffman's *New Experiments and Observations upon Mineral Waters*.

^g See *Nov. Organ.* Part II. Sect. 11.

^h Compare this with the *Speculations* of Mr. Boyle and Dr. Hoffman upon the same Subject. See also below, Sect. XV. 24.

DuSility of Gold.

2. (1.) Gold acquires an immense Dilatation by the Hammer, as we see in Leaf-Gold; so again by Drawing, as we see in the Gilding of Silver-Wire: for the Mass of Silver is gilt over, before 'tis drawn out into Wireⁱ.

Silver.

3. (2.) Silver also is, by the Hammer, reduced to Leaves; tho not so exquisitely thin, as Gold. The other Metals also may be hammered into thin Plates.

Wax.

4. (3.) Wax, and the like Bodies, may be formed, moulded, and wrought into thin Cakes, Cases, or Coverings^k.

Ink.

5. (4.) A Drop of Ink in the Pen is dilated, and spread out into a great number of Lines and Letters: and the same holds true of the Paint of a Painter's Brush, Varnish, &c.

Saffron.

6. (5.) A small Quantity of Saffron tinges a large one of Water^l. And thus much for the Dilatations, Rarifications, and Relaxations of Bodies.

S E C T. XIII.

Of CONTRACTIONS by the Emission or Discharge of a BODY received.

T R A N S I T I O N.

Contraction, and Condensation to be treated separately.

1. **W**E must next, with the like Diligence, enquire into the Actions contrary to the foregoing; viz. into the *Contractions*, *Condensations*, and *Closures* of Bodies. And it seems best to treat this Business apart; the rather, because all the Actions are not here reciprocal; but some of them peculiar, that require to be explained by themselves. And altho they may agree in a contrary respect, yet they are discovered and exhibited by very different Experiments.

Contraction by Expulsion, reciprocal to Dilatation by Introsusception.

2. The *Action of Contraction*, by the Emission or Expulsion of another Body, is reciprocal to the Action of Dilatation, by the Introsusception of another Body; and therefore this must be first enquired into.

3. (1.) Consult the Instances of *Dilatations by Introsusception*; and compare them with the same Instances after the Dilatations cease, in Bodies where this Cessation happens.

Metals recoverable.

4. (2.) The pure and perfect Metals, tho changed and tortured various ways, by Sublimation, Precipitation, Amalgamation, Solution, Calcination, &c. are yet generally recoverable by Fire and Fusion, and convertible into themselves again: the metalline Nature having no great Agreement with other Bodies. But this Condensation is the less genuine, as it seems to be

ⁱ For the quantity of this kind of Dilatation consult Mr. Boyle's Philosophical Works; and Dr. Halley's Computation, in the *Philosophical Transactions*.

^k As in the Callico-Wrapper, of the *East-Indies*.

^l There are many pertinent Instances to this purpose in Mr. Boyle's *Pieces upon Colours, Effluvia, Phosphori, &c.*

be nothing more than an emission and exclusion of the Air, interposed ; or of the Menstruums in which the Metals were dissolved ; thus giving an Opportunity for the pure Parts of the metallic Body to unite again. And, doubtless, the Body possesses much less Space than before ; tho it does not seem to become denser in its Substance. This *Power of the Keys*, which opens and shuts, reigns principally in Metals. And thus foul Metals, as also Marcasites and Ores, are purified ; the homogeneous Parts of them being collected together by the Fire ; and the Dust and Dross thrown off and excluded : for every pure Metal is more dense and ponderous, than the same when impure.

5. (3.) It contributes to condense Metals, if they be often melted, and quenched in Waters ; whereby they become more hard and stubborn : but whether their specific Gravity be increased by this means, is not hitherto ascertain'd ; and requires a particular Experiment ^m. This Induration, however, is more powerfully effected by frequent Solutions and Restorations, than by Fusions and Exinctions : and it should likewise be examined, in what kinds or mixtures of Waters, Metals acquire the greatest Hardness. *Metals, how condensed.*

6. (4.) There are certain ways of killing and destroying Metals ; so that when dissolved and opened, they shall be no longer capable of Reduction. And something of this kind appears remarkably in Quicksilver ; which, if forcibly ground along with a little Turpentine, Spittle, &c. the Quicksilver is killed, and thence acquires an Aversion to recover its pristine Form ⁿ. *Demetallized.*

P R E C E P T.

7. Diligent Enquiry should be made into the Business of *mortifying Metals*, *The Business of* or preventing their Reduction, or Restitution ; for they must have a great Antipathy to those things which thus prevent their Parts from coming together. And as all Restitution of Metals is a certain kind of Condensation ; a knowledge of the *Privation* will here regard the knowledge of the *Form*. *Demetallization to be farther prosecuted.*

H I S T O R Y.

8. There is properly, no reciprocal Action opposed to the Dilatations proceeding from the native Spirit expanding itself ; Contraction being a Thing foreign to Spirit, which is never contracted, unless it either *No Reciprocal to Dilatation of the Spirit.*
VOL. III. B b b b suffers,

^m It has been tried in Steel, perhaps, and two or three other Metals ; but there ought to be a Table formed, including the different Gravities of all the Metals, after being heated and quenched, a certain number of Times, in various Liquors ; as well Waters of different sorts, as the Juices of Plants, saline Solutions, &c. See M. Reaumur's *Treatise of converting forged iron into Steel ; and of softening Cast Iron, so as to make Works thereof, equally perfect with those of forged Iron.* Published at Paris, An. 1722.

ⁿ For the business of Demetallization, see Boyle, Becher, Homberg, and Stahl : but farther Experiments, and more decisive, are still wanting on this Head.

suffers, is suffocated, or collects itself, in order to dilate more forcibly. We might, however, here commodiously substitute the proper Action of the grosser Parts ; which is an Action that may, by Accident, be attributed to the native Spirit ; when, thro' the escape or emission of the Spirit, the Parts are hardened and contracted. Now the Spirit is discharged, either by its own proper Agitation, the Sollicitation of the external Air, or the Provocation, or Irritation, of Fire or Heat.

SPECULATION.

*The Action of
Heat and Age.*

9. Fire or Heat, and Time or Age, have one and the same Effect, as to the attenuation and discharge of the Spirits, and the Actions which follow thereon. But Age, of itself, is no more than a Period, or measure of Motion ; and therefore, when we speak of Age, we mean a Virtue and Operation, compounded of the Agitation of the native Spirit, the surrounding Air, and the Rays of the heavenly Bodies. But there is this Difference, that Fire and vehement Heat dilate Bodies suddenly, visibly, and powerfully ; but Age, like a very gentle Heat, by degrees, slowly, and secretly : for gross Fumes and Vapours are conspicuous ; but not the finer Perspirations or Effluvia ; as is manifest in Odours*. But the Attenuation and Rarification of Bodies by Age, is more subtle and exquisite than that by Fire ; for Fire being sudden in its Action, causes the pneumatical Parts of Bodies to fly off in a hurry ; sometimes also, converting the prepared Humidity into pneumatical Matter, and discharging it : whence the tangible Parts strongly wedge one another in ; and thus, forcibly, arrest and detain a considerable part of the Spirit. But Age does not suddenly solicit a Discharge of what is rendered pneumatical ; which therefore, by remaining longer in the Body, gradually and regularly prepares whatever may be digested into a fine Substance ; whilst but little of the pneumatical Matter already formed, gently, and successively steals away : so as, in a manner, to anticipate, and as it were undermine the Connexion and Closeness of the tangible Parts. And, therefore, in Dissolutions by Age, there is found at the last, but very little tangible Substance remaining fixed or clinging together. For the rotten Powder, left after a long Series of Years, as the Remains of the Depredation, such as is sometimes found in old Monuments and Sepulchers, appears but like the Carcass of the Matter ; and is more effete and exhausted than any Ashes made by the Fire : for Ashes have still a Juice that may be drawn from them, and turned into Salt ; whereas this kind of Powder contains no Juice, nor Salt at all†. But the thing here intended, with regard to the present Enquiry, is, that this Spirit, so long as it is detained in the Body, resolves, mollifies, wears, and preys upon the tangible Parts, which, after that is discharged, presently contract and lock themselves close together.

SECT.

* See Mr. Boyle upon Effluvia.

† See the whole of this Speculation illustrated and confirmed in Boerhaave's *Chemistry*, particularly under the *Processes upon Vegetables*.

S E C T. XIV.

Of CONTRACTIONS by the Shrinking in of the grosser
PARTS, after the Discharge of the SPIRITS.

H I S T O R Y.

1. **T**HE Skins and Membranes of Animals grow dry and wrinkled with old Age. *Contractions instanced in Skins.*
2. Such Pears and Apples as have been long kept, grow shrivel'd ; so likewise the Kernels of Nuts contract and shrink from their Shells. *Fruit.*
3. Old Cheeses have their Coats wrinkled ; Posts, Wood-Pillars, Pales, &c. contract in their Dimensions by long standing, crack, gape and separate ; especially when set up green. And the like happens in solid Bowls or Balls of Wood. *Wood-work.*
4. The Earth cracks and chops in great Droughts, and becomes full of Chinks on its Surface ; and these Cracks sometimes reach so deep, that Water issues out thereat. *The Earth.*

A D M O N I T I O N.

5. Let no one triflingly pretend, that this Contraction, in the case of Dryness, is no more than a Consumption of Humidity ; for if that were all, and only the Moisture, converted into Spirit, flew off ; Bodies would then retain their former Dimensions, and barely become cavernous, like Cork or Pumice ; and not be locally contracted, and lessen'd in their Dimensions^a. *Contractions more than Dryness.*

H I S T O R Y.

6. Clay is burnt into Brick and Tyle in the Kiln ; but if the Heat be violent, as in the middle of the Furnace, some part of the Clay is also changed in its Nature, and run into Glass. *Clay vitrified.*
7. If Wood be set on Fire, and the Flame be stifled, the Wood turns to a Coal ; or a Substance more light and spongy than Wood^b. *Wood changed.*
8. Most of the Metals when covered in a Crucible, and set in the Fire, especially in a reverberatory Furnace, are converted into a friable Substance, and calcined. *Metals calcined.*
9. Many fossil, or metalline, and some vegetable Matters, are vitrified by a strong Fire. *Metals vitrified.*

B b b b 2

10. All

^a See Dr. Hook's *Micrographia* passim ; and Dr. Grew's *Anatomy of Plants*;

^b For the full Process, see Mr. Evelyn's *Sylva* ; or Boerhaave's *Chemistry*.

- Turnefable Bodies changed.* 10. All Bodies capable of Tumefaction turn to a coaly Substance, and contract their Dimensions, if too long exposed to the Fire.
- Paper curled by Heat.* 11. Paper, Parchment, Skins, &c. are not only made to wrinkle in their Parts by the Fire; but also to curl, or coil, and wind their whole Substance into a Roll.
- Tinder.* 12. Linen Cloth being fet on flame, and presently extinguished, turns into a light Substance, which scarce takes Flame again, but easily ignites; as in the case of Tinder.
- Unctuous Bodies made empyreumatic.* 13. Fat Bodies, as Wax, Butter, Oil, &c. become scorched, foul, and as it were smoky by the Fire.
- Eggs.* 14. Eggs contract in Bulk by the Fire, and change the Transparency of their Whites into an opaque Whiteness.
- Bread.* 15. If an Egg be broke into high rectified Spirit of Wine, it turns white and hard; as if it were heated over the Fire. So likewise Bread steep'd in the same Spirit, appears almost as if it had been toasted.

OBSERVATIONS.

- The Cause and Process of Contraction, upon the Escape of the Spirit.* 16. (1.) So long as the Spirit is detained in a Body, and excited and dilated by Fire, or Heat; so long it keeps itself in agitation, endeavours its own Escape, softens, supples, and fuses the tangible Parts together: and thus to digest, subdue, and work together the Parts of Bodies, is the proper Office of the Spirit. But after the Spirit has once found an Exit, and is discharged, then the Work of the Parts takes place; and, having been tortured by the Spirit, now combine together, and wedge themselves close; as well thro' an Appetite of Connexion and mutual Contract, as an Aversion to Motion and Disturbance. And upon this follows Closeness, Hardness, and a Stubborness of the Body.
- The End of Contraction by Fire.* 17. (2.) There is a Limit and ultimate End of the Process of the Contraction in the Parts of Bodies by Fire; for if the Quantity of Matter be too small to cohere thro' the violent Depredation of the Fire, the Parts desert each other, are turned to Ashes, and calcined. And thus much for the Contractions occasioned by the Discharge of the Spirit of Bodies; whether it proceed from Age, Fire, or potential Heat.

S E C T. XV.

Of the Contractions of BODIES by actual, external Cold.

T R A N S I T I O N.

1. **R**Eciprocal to the Action of *Dilatation by actual external Heat*, is the Action of *Contraction by actual external Cold*. And this Condensation is, of all others, the most genuine and proper ; and would likewise be the most powerful, if we had here, upon the Surface of the Earth, any intense degree of Cold. But Cold, or a Remission of Heat, (both which we here consider together) simply condenses some things, without altering their Nature ; restores others, tho imperfectly, that are rarified ; and again, perfectly converts and transforms others, by Condensation, from one Nature to another^f : each of which we must here touch upon, in their turn.

Condensation by Cold the most genuine Condensation.

H I S T O R Y.

2. (1.) Air, in a Thermometer, is sensible of the Degrees both of Cold and Heat. And, in the Winter, we have sometimes placed a kind of Cap of Snow, upon the Head of the Glass ; which has so much increased the Cold, even in a snowy Season, as to raise the Water a few Degrees higher, by condensing the Air[†].

Instances from the Thermometer.

3. (2.) We above observed, that the Air in this Glass was dilated a Third ; and contracted itself as much, upon a remission of the Heat.

P R E C E P T.

4. (1.) It deserves to be tried by particular Experiments, whether Air dilated with Heat, might be fixed in its Expansion ; so as not to endeavour its own Restoration and Contraction. Take, therefore, a strong Glass Tube, heat it violently, then perfectly close up the Orifice, that the Air may not contract ; and let the Glass stand for some Days thus closed : afterwards plunge it, still stoppt, into Water ; open it under the Water, and observe how much Liquor it draws in ; or how the Quantity is, in proportion to what it would have attracted, if the Glass had been directly put into Water[‡].

To try if rarified Air may be fixed.

5. (2.) Observe likewise, by the way, with regard to the Title of Heat and

^f See hereafter, § 36.

[†] See *Novum Organum*, Part II. Aph. 13. (38.)

[‡] The Experiment might be better tried in the Condenser, with strongly compressed Air. See Mr. Boyle's *Experiments upon the Spring of the Air*.

The History of CONDENSATION,

and Cold, whether Air so strongly dilated, and forcibly detained, retains its heat much longer than when the Orifice of the Glass is left open.

HISTORY.

Apparent
Magnitude of
the Stars.

6. (1.) In very clear and cold Nights, during the Winter, the Stars appear larger than in the serene Nights of Summer; which proceeds principally from the general Condensation of the Air at that time, inclining it more to the Nature of Water: for all things appear much larger in Water.

Dews.

7. (2.) Morning Dews are, doubtless, Vapours not perfectly dissipated, and converted into pure Air; but hang imperfectly mixed, till by the cold of the Night, especially in that called the *middle Region of the Air*, they are reflected back, and condensed into Water.

Rain and
Snow.

8. (3.) The Condensation of Rain, Snow, and Hail, proceeds likewise from the Cold of the middle Region; which generally coagulates Vapours higher up than Dews. But here occur two Difficulties, which should be carefully examined. The *first* is, whether the Drops of these Meteors are congealed and condensed, in their Fall; or, whether they were first collected into larger Masses of Water, that hung pendulous in the Air, on account of their Distance from the Earth; and were afterwards broke and reduced to Drops, by any Violence: for there are certain Cataracts, or Rains, in the *West-Indies*, which descend so thick and sudden, as if they were poured out of Vessels. The *other* is, whether not only Vapours, which were Water before; but also a large part of pure and perfect Air be not coagulated and really changed into Rain, &c. by the vehement and intense Cold of those Regions.

Distillation.

9. (4.) In Distillations, Moisture is first converted into Vapour; which being now deserted, thro' its distance from the Fire, dashed against the sides of the distilling Vessel, and sometimes cool'd by the external Application of cold Water; restores itself to Liquor again. This seems to be a familiar Emblem of the Process of Dew and Rain.

Volatilized
Metals.

10. (5.) Some metalline Matters, as particularly Quicksilver, when made volatile, have a sudden Tendency to restore themselves; and greatly affect to meet with a solid Body in their way. And hence they easily stick, and easily fall off again; insomuch that 'tis sometimes necessary to pursue their Fumes, with the Fire; and transmit them from one degree of Heat to another; as it were in an ascending Scale, or Series of Fires, placed at some distance from one another, about the Vessel; lest the Fume, after ascending, and

* It has not hitherto perhaps been evidently manifested by Experiment, that Air is condensable into Water. But the Experiment of attracting all the Moisture out of a certain quantity of Air, as it remains in a close Vessel, by means of the common *Causitic*, or other fixed alkaline Salt, deserves to be carefully prosecuted. For when this Experiment is exactly made; it should seem as if almost the whole weight of the Air were acquired by the Salt. The Vessel should here be large; the Scales well made; the Salt perfectly dry, and hot; and all the parts of the Operation performed with care; so as to prevent being imposed upon thro' Oversight.

and being removed from the first Fire, should restore itself sooner than it ought *.

11. (6.) Such Things as melt at the Fire, grow dense upon a Remission *Melted Mat-* of the Heat, and solid as before; which is the case of Metals, Wax, *ters.* Fat, &c.

12. (7.) A Fleece of Wooll gains weight by lying long upon the Earth; *Vapours.* which could not happen, if some pneumatical Matter were not condensed into such as is tangible and ponderous.

13. (8.) It was an ancient Practice, at Sea, to spread and hang out Fleeces of Wooll, by Night, on the sides of Ships; but so as not to touch the Water; and by this means to collect and express a sweet Water out of them, in the Morning; for the Service of the Voyage.

14. (9.) I have found, upon trial, that four Ounces of Wooll being fasten'd to a Rope, and let down into a Well, fifty six Yards deep; but so as to come only within twelve Yards of the Water; the Wooll has, in a Night's time, acquired the additional weight of an Ounce and a Dram: and perfect Drops of Water have appeared to stick on the out-side of the Wooll; so that one might, in a manner, have washed ones Hands therewith. And this I have several times tried, with different Increases of Weight; but always somewhat considerable.

15. (10.) Stone, Flint, and Marble; as also Rails and other Wood- *Sweating of* work, especially if painted, appear manifestly moist and dewy upon Thaws, *Houses.* or in particular Seasons, when the Wind is southerly; so that they seem to sweat: and may have Drops of Water brushed off from them.

16. (11.) In Hoar-frosts there is a Collection of the hoary Matter found *Frost on Win-* froze on the Windows of Houses; and this to a greater degree on the *dows.* inside than on the outside of the Glafs.

17. (12.) The Breath, which at first is but Air drawn in, and moisten'd *The Breath;* by a short Stay in the Cavity of the Lungs, appears turned into a kind of dewy Substance, upon Looking-glasses, Gems, Sword-blades, and the like polish'd Bodies; and afterwards dissipates, like a fine Cloud.

18. (13.) Linen is found to contract a Moisture within Doors; so as to *Linen.* reek before the Fire.

19. (14.) All Powders collect a Moisture in the Closets or Places where *Powders.* they stand close shut up; so as to cling together, or form as it were a Mass.

20. (15.) Some imagine that the Origin of Springs, and sweet Waters, is *Origin of* owing to the Air shut up, coagulated and condensed in the Cavities of the *Springs.* Earth; but particularly the Cavities of Mountains.

21. (16.) Mists are imperfect Condensations of the Air, consisting of a *Mists,* large Proportion of Air, and a small one of aqueous Vapour: and these happen in the Winter, about the change of the Weather, from Frost to Thaw, or from Thaw to Frost; but in the Summer and the Spring, from the Expansion of the Dew.

P R E-

* As in the Preparation of Butter of Antimony, &c. which stick in the Neck of the Retort, and require to be melted down, by applying live Coals on the outside of the Glafs.

P R E C E P T.

To attempt the
Conversion of
Air into Wa-
ter.

22. As the conversion of Air into Water, would be a thing extremely useful ; all the Instances having any Tendency this way, should be carefully consider'd * : in particular, it should be ascertain'd, whether the Exudations of Marble, and the like Bodies, in rainy Seasons, and southerly Winds, are mere Condensations of the Air, reflected by the hardness and smoothness of the Body, like the Breath on a Looking-glass ; or whether they participate at all of the internal and pneumatical Juice of the Stone, &c. Trial may be made of this by laying a Cloth upon the Stone ; for if the Stone should sweat in this case also, the Exudation must participate of an internal Cause †.

S P E C U L A T I O N.

Air convertible
into Water.

28. That Air is converted into Water, in the upper Regions, seems certain, from the Conservation of Things ; for, doubtless, the Moisture of the Sea and Earth, is converted into pure Air, after it has by Time, Association, and a plenary Rarification, totally put off the Nature of Vapour ; and therefore, if there was not sometimes a mutual change of Air into Water, as well as of Water into Air, there could not be a sufficient Stock of new Vapours, imperfectly mixed, to supply Rains and Showers, for refreshing and renewing all the Species of Bodies ; but there must necessarily follow unsupportable Drought, and Conflagrations, violent Winds, and Tumefactions of the Atmosphere, from a continual Multiplication of Air †.

H I S T O R Y.

Water in free-
zing.

24. (1.) Water in freezing does not shrink, but swell in its entire Bulk ; and yet it suffers a manifest Condensation of Parts ; inasmuch that there appear Cracks and Separations within the Body of the Ice : and sometimes, if the Air be permitted to enter, something like Hairs, Strings, and Flowers, appear by degrees. Yet Ice floats on Water : whence 'tis manifest that the Condensation is not total †.

Wine.

25. (2.) Wine freezes slower than Water ; and Spirit of Wine does not freeze at all.

26.

* See above § 8.

† It now seems generally allow'd that the Moisture in this case proceeds entirely from the Air, and not from the solid Bodies ; which only condense the dewy Vapours floating in the Air. But whether there be not also some Conversion of the Air into Water is another Question. See the *History of Winds*, passim. See also the following *Speculation*, and § 8. above.

‡ Compare this with Sir Isaac Newton's Queries to the same purpose, at the end of his *Opticks*. See also the Author's *History of Winds*, passim.

§ See above, *Sett.* XI. 8.

26. (3.) Mineral acid Spirits, and Quicksilver, have not hitherto been *Acid Spirits* brought to freeze ^b.

27. (4.) Oils and Fats, freeze, and are thereby condensed: but not to a *Oils* degree of impenetrable Hardness.

28. (5.) Frost makes the Earth concrete together, and renders it dry *Effects of Frost* and hard: and in the northern Regions, the Poet observes, that Metals *on Metals* are frequently observed to crack ^c. And the like we find among ourselves, in Tables, or other Wood-work; especially where the Parts are glew'd together. And 'tis reported, that even Nails have, by the contraction of Cold, been made to fall from the Walls they were drove in ^d.

29. (6.) Animal Bones become more brittle in frosty Weather; info- *And Bones* much that Fractures are, at such times, more common, and difficult of cure. In short, all hard Bodies become more brittle by Cold.

30. (7.) Waters, or Juices, are manifestly condensed into shining or cry- *Petrified* stalline Stones; as appears in subterraneous Caverns seated among Rocks, *Juices* where are found Isles of various Forms, like the common; only fixed and stony; hanging pendulous in their slow Fall, or Descent from the Roof or Arch; and being congeal'd in the Passage: but whether the Matter of them be totally aqueous, or the native Juice of the Stone, with some other Mixture, is a Question; especially as Gems and Crystals often shoot, and rise upwards out of opened Rocks, and do not fall or hang pendulous downwards: which is a Phenomenon that cannot well be attributed to the Water lodged there ^e.

31. (8.) Clay is evidently condensed into Stone; as appears from certain *Clay turned to* large Stones composed of little ones, cemented together by a stony Matter, *Stone* as polite and hard as the Stone itself: tho' this Condensation seems not to proceed from the sole Coldness of the Earth; but from Assimilation; of which more hereafter ^f.

32. (9.) There are certain Waters which condense Wood, and other *Wood petri-* light Bodies, into a stony Matter; so that the lower part of the Body, *fied* which was under the Water, shall be Stone; and that above, remain Wood: and hereof I have myself seen Instances. This is a Particular which should be well enquired into; as it may afford great Light in the practical Business of *Condensation* ^g.

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C c c c

P R E-

^b Oil of Vitriol, if extremely strong, or perfectly dephlegm'd, will appear congealed in an intense Cold.

^c *Æraque dissiliunt vulgò, vestesque rigesunt.*

^d See Mr. Boyle's *History of Cold*.

^e See Mr. Boyle of the *Origin and Virtues of Gems*; and the Accounts of the *Caves Gostiers*, given in the *French Memoirs*.

^f See *Señ. XVIII.*

^g In particular, let due Enquiry be made, whether it is not owing to the Insinuation of a petrescent Matter, into the Pores of the Wood; or whether this be a true and proper Conversion. See the *Articles ALTERATION, PERCOLATION, PUTREFACTION, and TRANSMUTATION, in the Sylva Sylvarum.*

P R E C E P T.

To try if metallic Waters will not petrify.

33. 'Tis possible that *metallic Waters*, by reason of the Density they contract from the Metals, may have a petrifying Virtue: and of this let trial be made with Straw, thick Leaves, Wood, &c. But we conceive such *metallic Waters* should be chose, as are made by frequently washing, or quenching, Metals therein; rather than by Solution; lest the corrosive Menstruums, which must otherwise be employ'd, should hinder the Condensation^h.

H I S T O R Y.

China Earth.

34. (10.) In *Cbina* they have artificial Mines of Porcellane Earth, by burying, at some depth under Ground, a certain Mass of prepared Plaster, or Cement; which lying thus buried for about forty Years, is converted into Porcellane. So that these Mines are transmitted, like an Estate, from Father to Son.

Eggs petrified.

35. (11.) I have been well assured that an Egg, by long lying at the bottom of a Moat, was found manifestly petrified; with the Colours and Distinctions of the Shell, White and Yolk, still remaining: only the Shell was here and there broke, and shone scaly. And I have frequently heard that the White of an Egg has been turned to a stony Matter; but neither know the truth of the thing, nor the manner of doing it.

Flame of Spirit of Wine.

36. (12.) Doubtless Flame, upon being extinguish'd, is converted into something; viz. an After-fume; which is again converted into Soot: but the Flame of Spirit of Wine, and the After-expiration of such pure inflammable Substances, should be carefully examined; in order to discover what Substance they are condensed into, and what kind of After-exhalation they afford: for it does not appear to be any thing fuliginous; as in the case of Flame from oily Bodiesⁱ. And so much for the *Contractions of Bodies by actual Cold*, in Air, in Water, in Liquors and in Flame; whether the Contraction were *Simple*, a *Restoration*, a *Coagulation*, or a *Conversion*.

S E C T.

^h Let a proper Analysis be made of the Water of certain known *petrifying Springs*, or *Lakes*; in order to discover the Contents of such Waters; from whence artificial petrifying Waters might, perhaps, be made in imitation of the natural. There are some Accounts in the *Philosophical Transactions* of such petrifying Waters, and petrified Substances.

ⁱ See M. Geoffroy's *Memoir upon the Method of discovering and ascertaining the Quality of Brandies and Spirit of Wine*; where he has a particular Method of burning Spirit of Wine; so as apparently to resolve a large Proportion thereof into Water. *Memoir. de l'Acad. An. 1718.* See also Dr. Stahl's three hundred Experiments and Observations, printed at Berlin, An. 1731.

S E C T. XVI.

The History of the C O N T R A C T I O N S *of Bodies by*
Potential Cold.

T R A N S I T I O N.

1. **W**E next proceed to the Action opposite to *Dilatation* by potential Heat; viz. *Contraction* by potential Cold.

2. (1.) As the *medicinal Tables of secondary Qualities* are to be consulted in *Tables of secondary Qualities* the Enquiry of *potential Heat*; so are they likewise in that of *potential Cold*; particularly with regard to *Astringency, Revulsion, Infarction, Inspissation,* and *Stupescation*.

3. (2.) Opium, Henbane, Hemlock, Nightshade, Mandrake, and the *Stupescatives*, like Narcoticks, manifestly condense the Spirits of Animals, turn them back upon themselves, stifle and deprive them of Motion: and whether they have any effect upon dead Bodies, may be tried by steeping Flesh in their Juices; to see if any Blackness or Gangreen will ensue; or by soaking Seeds and Kernels therein; to observe whether it will kill them, and prevent their growing; or again, by besmearing the top of a Thermometer, on the inside, with their Juices; to discover whether this will, in any measure, contract the Air^k.

4. (3.) There are found in the *Weji-Indies*, even in sandy Desarts and *Water-Canes*, very dry Places, large Canes containing, in every Joint, a considerable quantity of sweet Water; to the great Refreshment of the Traveller.

5. (4.) There is said to be a certain Tree in one of the *Canary Islands*^l, that continually distils Water; and has a certain dewy Cloud always hanging over it. 'Twere highly worth examining, whether any Vegetable has such a potential Coldness, as to condense Air into Water. Of this Particular therefore let diligent Enquiry be made^m. Tho I rather suspect that these Trees are no other than the knotted Canes above-mention'd.

6. (5.) Upon the smooth Leaves of certain Trees, as those of the Oak, *Honey Dews*, that neither drink in nor preserve Moisture, there are found in *England*, sweet, or as it were, honey-Dews, like Manna; especially in the Month of *May*: but whether this proceeds from any coagulating Virtue in the Leaves, or whether the Leaves only preserve the Dew, is not certainⁿ.

C c c c 2

7. (6.)

^k There seem to be few Experiments of this kind extant.

^l It is the Island *Ferro*, the most western of the *Canaries*.

^m There are two or three Accounts of this Tree to be found in *Purchas*. One of them runs thus: "In the Island *Ferro*, they have no other Water but that which proceeds in the night from a Tree encompassed with a Cloud; whence Water issues, serving the whole Island, both Men and Cattle: a thing notorious, and known to very many." *Purchas*, Vol. II. Pag. 1673. See also, in the same Author, the *Observations of Sir Richard Hawkins*, Vol. II. pag. 1367, 1368, and 1369. and the Note at the Bottom.

ⁿ Or whether it be not the condensed saccharine Juice of the Tree, exuding along with the other aqueous Juices, and dried by the Sun upon the Surface of the Leaf.

Nitre.

7. (6.) There is scarce any Substance wherein potential Heat is so remarkable as in Nitre : for as Spices and other Bodies, tho they have no perceptible Heat to the Touch, yet they have it to the Tongue, and the Palate ; so Nitre has a perceptible Coldness in the Mouth, beyond that of House-leek, or any of the coldest Plants : whence Nitre seems a fit Subject for proving the Virtue and Efficacy of potential Cold.

P R E C E P T.

To try whether
Nitre will con-
dense by its
potential Cold.

8. Take, therefore, a small and extremely fine Bladder ; blow it up ; tie it, and bury it in Nitre for some Days ; then take it out ; and observe if the Bladder be any way shrunk : if it be, conclude that the Nitre contracted the Air. Let the like Experiment be tried with Quicksilver, by plunging a Bladder therein ; the Bladder being tied down, to prevent its rising, and to avoid the necessity of keeping it pressed.

H I S T O R Y.

Vinegar conso-
lidating Un-
guents.

9. If Vinegar be put to Ointment of Roses, or the like unctuous Body, the Ointment is so far from being thinn'd thereby ; that on the contrary it becomes more hard and solid.

S E C T. XVII.

Of the Contractions of Bodies by Flight, and Antiperistasis.

T R A N S I T I O N.

Contraction by
Antiperistasis
opposite to Con-
traction by
Consent.

1. **O**PPPOSITE to the Action of Dilatation by Consent, or Embrace, is that of Contraction by Flight and Antiperistasis : for as Bodies every way open and relax themselves to such as are friendly and agreeable, and even run to meet them ; so when they happen upon such as are unfriendly and odious, they avoid them every way ; contract, and shrink themselves up.

H I S T O R Y.

Instanced in
Fire,

2. (1.) The Heat of Fire seems to be somewhat condensed, and rendered sharper by Antiperistasis ; as in frosty Weather.

2. On

3. On the contrary, in the torrid Zone, Cold seems to be condensed, by *Antiperistasis*; so that if any one there shelters himself under a Tree, from the scorching Heat of the Sun, he presently shivers with Cold.

4. (2.) This Operation of *Contraction* by *Antiperistasis* is not without some pretence of Reason, attributed to the middle Region of the Air; where Cold collects and unites itself, to avoid the scattered Rays of the Sun from above; and the reflected Rays from the Earth: whence there are great Condensations made in that Region of Rain, Snow, Hail, &c. *In the middle Region.*

5. (3.) It may, with Justice, be doubted whether Opium and other Narcotics, stupefy by potential Cold; or by putting the Spirits to flight: for Opium, by the strength of its smell, its bitterness, sudorific Virtue, and other Signs, seems to have hot Parts: but as it may emit a Vapour, disagreeable and odious to the Spirits; it may every way put them to flight; and so coagulate and stifle them. *Opium.*

S E C T. XVIII.

Of the Contractions of Bodies by Assimilation, or Conversion into a denser State.

T R A N S I T I O N.

1. **O**PPPOSITE to the Action of Dilatation by *Assimilation*, and *Conversion*, into a rarer Body, is the Action of *Contraction* by *Assimilation*, and *Conversion*, into a denser: supposing it to be done not by Cold, whether actual or potential; but by the power of a more active Body, which multiplies itself upon one that is more passive. But Assimilation to a state of Density is less frequent, and much less powerful, than to a state of Rarity; because dense Bodies are more sluggish, and unactive, than rare ones, in the business of assimilating. *Contraction by Assimilation opposite to Dilatation by Assimilation.*

H I S T O R Y.

2. (1.) We above observed, that Clay intermix'd among little Stones is condensed into a stony Matter. *Clay condensed to Stone.*

3. (2.) The sides of the Cask condense a recrementitious part of Wine into Tartar. *Wine to Tartar.*

4. (3.) The Teeth condense what adheres to them from chewing the Food and from the moisture of the Mouth, into Scales; which may be scraped off with an Instrument, tho they have the hardness of the Teeth. *Scales of the Teeth.*

5. (4.) All hard and solid Bodies condense some part of the Liquors adhering to them, on the sides; but principally at the bottom. *Solids condensing Fluids.*

6. (5.) Whatever Aliments are converted into a nourish'd Matter, more dense than the Matter of the Aliment, is plainly condensed in the Assimilation; thus the Meat and Drink of Animals is condensed into Horn, Bone, &c. *Aliment.*

S E C T. XIX.

Of the CONTRACTIONS of Bodies by external Violence.

T R A N S I T I O N.

The Action opposite to Dilatation by external Violence.

1. **O**PPPOSITE to the *Action of Dilatation by external Violence*, whether with or against the Appetite of the dilated Body, is the *Action of Contraction by external Violence*; when Bodies are put under a Necessity of giving way to the Things that act thereon, and so of compressing themselves.

H I S T O R Y.

Instanced in Air.

2. (1.) Air easily suffers some degree of Condensation, by external Violence, or Compression; but will not endure a large one: as appears from stormy Winds and Earthquakes.

The Diving Bell.

3. (2.) If a wooden Bucket be inverted, and forced perpendicularly down with the Hand into Water, it will carry Air down with it to the bottom; without admitting Water into it; except a little about the Edges: as will appear by the colour of the Wood, which shews the exact Measure of the Air's Compressure within. This appears still more eminently in that useful Invention the *Diving-Bell*, for working under Water; being no more than a large Concave Vessel of Wood, fill'd with Air, and made to stand upon three ponderous metalline Feet, somewhat below a Man's height, in order to sink it. This Vessel is let down into the Water; and when the Divers want to take Breath, they stoop, put their Heads into the Cavity, and there breathe freely. And by this Help occasionally, they can continue their Work under Water for some time; or till the Air, part whereof comes out each time the Head is thrust in, becomes too little for the purpose.

The Law of Contraction.

4. (3.) The rarer Bodies are, the easier they contract themselves at first; but the more they are compress'd beyond their natural Dimensions, the stronger they resist: as is manifest in Flame, and condensed Air close confined.

Flame compressed.

5. (4.) Flame, tho but simply compress'd, (even without a Blast, as in Gunpowder,) rages violently; for Example, in Reverberatory Furnaces, where the Flame is check'd, confined, beat back, and diverted in its Course.

A D M O-

¶ Or else is spoiled by having already served for Respiration. See the late Improvements of the Diving-Bell, in the *Philosophical Transactions*, N^o. 349.

ADMONITION.

6. *Dilatation by Diffusion* has no reciprocal Action oppos'd to it ; because the Bodies diffus'd are not amass'd together again, unless by melting ; as in the Reduction of Metals ; which we have mention'd above ^{*Dilatation by Diffusion has no Correlative.*}

SPECULATION.

7. There is also, perhaps, another kind of *Contraction of Bodies*, which is not reciprocal, but positive, and by itself : for we conceive that in the Solution of Bodies by Liquors ; as for Instance, Metals, Gums, Sugar, &c. the Body is somewhat received within the Liquor ; and yet the Liquor is not dilated or expanded in Bulk, proportionably to what it takes in. And if so, there must be a Condensation ; because the same space will then contain more Matter. 'Tis certain, in the Solution of Metals, that when once the Menstruum is fully saturated, it will operate or dissolve no more. And this kind of Condensation, if there be any such, we may call the *Contraction of Bodies by Saturation.* ^{*Contraction of Bodies by Saturation.*}

PRECEPT.

8. Compress Ashes close together ; then pour Water upon them ; and carefully observe how far they shrink, after they have taken in the Water ; in Comparison of the Bulk they had before, when mixed only with Air^f. ^{*Try Ashes and Water.*}

OBSERVATIONS.

9. (1.) The *Efficients* in the Dilatation of Bodies, discovered by the preceding Enquiry, are the nine following ; viz. (1.) The Introsusception or Admission of a foreign Body. (2.) A natural or preternatural Expansion of the native Spirit. (3.) Fire, or external actual Heat ; or even a Remission of Cold. (4.) External potential Heat, or auxiliary Spirits. (5.) The Release of the Spirits from the Prisons of the Parts. (6.) Assimilation, from the Prevalence of a rarer, and more active Body. (7.) Embrace, or the Attraction of Bodies related. (8.) Separation, or external Violence : and (9.) Diffusion, or a spreading out of the Parts. ^{*The Efficients of Dilatation.*}

10. (2.) The *Efficients* in the Contraction of Bodies are eight ; viz. (1.) Exclusion, or the discharge of a Body received. (2.) Shrinking, or Contraction of the Parts, after the Spirit is discharged. (3.) External actual Cold, or even a Remission of Heat. (4.) External potential Cold. (5.) Flight and *Antiperistasis*. (6.) Assimilation from the prevalence of a denser and more active ^{*The Efficients of Contraction.*}

^f See Sect. XIII. 5, 6.

^f See the Preface to Dr. Hook's *Posthumous Works* ; and Dr. Grew upon *Mixture*.

active Body. (7.) Compression by external Violence: and (8.) Saturation, if there be such a Thing ^t.

*The Actions
without their
Reciprocals.*

11. (3.) The Actions of Dilatation, (1.) by the native Spirit. (2.) by the release of the Spirits; (3.) by Diffusion; and, (4.) The Action of Contraction by Constriction, are without *Reciprocals*; but so are none of the rest.

*The spurious
Dilatations
and Contrac-
tions.*

12. (4.) The Dilatations by Introsusception, and by Diffusion, are spurious: so are the Contractions by Exclusion; as being not substantial but local.

*The simplest
Expansion.*

13. (5.) Expansion by Fire, or Heat, without Separation, is the simplest of all; and performed in a pure pneumatical Body, such as the Air; where nothing exhales, or subsides; but a mere Dilatation is made, to a considerable Bulk. Whether there be any Thing like this in Flame; that is, whether after the first Expansion of its kindling, which is considerable, it expands still farther, after it becomes a formed Flame, is hard to determine; because of its quick and momentary Extinction. But this belongs to the Subject of Flame.

*The next sim-
ple kind.*

14. (6.) What approaches next to this Dilatation in point of Simplicity, is the Expansion that happens in the melting of Metals; or the softening of Iron, Wax, &c. some time before any Thing becomes volatile and is discharged. This Dilatation is secret, and transacted in the Cavities of the entire Body; without visibly changing or enlarging its Dimensions: but as soon as any Thing begins to fly off, then the Actions become complicate, or partly rarifactive, and partly contractive; so that those contrary Actions of the Fire, vulgarly observed to harden one Thing and soften another ^u, depend upon this; that in one Case the Spirit is discharged, and in the other detained.

*Condensation
by Fire what.*

15. (7.) The *Condensation made by Fire*, tho not spurious, but substantial, is rather a Condensation of the Parts, than of the Whole: for the grosser Parts are certainly contracted; yet so as to render the entire Body more hollow or porous, and less ponderous.

S E C T.

^t See above §. 7.

^u *Limus ut hic durefcit, & hac ut Cera liquefcit,
Une eodemque Igni.*

S E C T. XX.

Variable CANONS, or improveable AXIOMS

1. **T**HE Total Sum of Matter in the Universe, ever remains the same; and there is no Passage, in Nature, either from Nothing, or to Nothing.
2. Of this original Sum, there is more in some Bodies, and less in others, under the same Dimensions.
3. A greater and less quantity of Matter afford the true Criteria, if rightly understood, of Density and Rarity.
4. There is a Boundary, or limited Degree of Density and Rarity; but not in any Subject known to us.
5. There is no absolute Vacuum in Nature.
6. Matter folds and wraps itself up within the bounds of Density and Rarity; and again, relaxes and unbends itself, without admitting an absolute Vacuity.
7. The Differences of Density and Rarity, in the tangible Bodies known to us, do not greatly exceed the Proportions of thirty two to one.
8. The Difference between the rarest tangible Body, and the densest pneumatical Body, is above a hundred to one.
9. Flame is rarer than Air, and Oil than Water.
10. Flame is not rarified Air, nor Oil rarified Water; but they are plainly heterogeneous Bodies, without any great Relation between them.
11. The Spirits of Vegetables and Animals are Breaths composed of an aerial and flamy pneumatical Substance; as their Juices are of one that is aqueous and oily.
12. All tangible Bodies, here with us, have a pneumatical Substance, or Spirit, join'd to, and included in them.
13. No Spirits, such as those of Vegetables and Animals, are found loose, and unconfined amongst us; but shut up, and imprison'd in tangible Bodies.
14. Condensation and Rarification are the proper Effects of Cold and Heat.
15. Heat operates upon pneumatical Bodies by simple Expansion.

The History of CONDENSATION,

16. Heat has two Operations upon tangible Bodies, and always dilates the pneumatical Parts; but sometimes contracts, and sometimes relaxes the gross ones.
17. It observes this Rule; when the Spirit of the Body is discharged, it contracts, and indurates; but softens and dissolves, when the Spirit is detain'd.
18. Colliquation begins with expanding the pneumatical Parts of the Subject; but other Dissolutions begin with expanding the gross Parts, and setting free the Operations of those that are pneumatical.
19. Next to Heat and Cold, the most powerful Rarifier and Condenser of Bodies is Consent and Flight.
20. Restoration from Violence both dilates and condenses, in a contrary Tendency to the Violence.
21. Assimilation both dilates and condenses; as the assimilating Body is rarer, or denser, than the Body assimilated.
22. The rarer the Body, the greater Expansion and Contraction it is capable of, from external Violence, to a certain degree.
23. If Tension, or Pressure, exceeds its bounds, in a rare Body; such a Body frees itself more powerfully, than a dense one; as being more active.
24. The most powerful Expansion, is that of Air and Flame conjointly.
25. Dilatation and Contraction are but imperfect, where the Bodies easily and readily restore themselves.
26. Density and Rarity have a great affinity with Gravity and Levity.
27. Man has but little Power in the business of Condensation, for want of a potent degree of Cold.
28. Age is like a lambent Fire, and acts like Heat; tho in a more exquisite manner.
29. Age brings Bodies either to a state of Putrefaction or Dryness*.

S E C T.

* Observe that these Canons or Axioms are deduced, as Corollaries, from the preceding Enquiry.

S E C T. XXI.

D E S I D E R A T A, *and their* A P P R O X I M A T I O N S.

D E S I D E R A T U M I.

1. *A* Method of condensing Air into Water.

A P P R O X I M A T I O N S.

The Approximations here are Springs in the Cavities of Mountains ; the Exudations of Stone ; the Condensations of the Breath into Dew ; the Method of hanging out woolly Matters on the sides of Ships to collect sweet Water at Sea ; the aqueous Meteors, &c.^w.

D E S I D E R A T U M II.

2. *A* Method of increasing the Gravity of Metals.

A P P R O X I M A T I O N S.

The Conversion of Iron into Copper ; the Increase of Lead in Vaults ; the Conversion of Quicksilver into Gold ; if such Things there are.

D E S I D E R A T U M III.

3. *A* Method of petrifying Earths, and other Substances, Vegetable or Animal.

A P P R O X I M A T I O N S.

Petrifying Waters ; compounded Stones, consisting of little ones crusted together ; Crystalline Ificles in Caves ; Stones in the Kidneys, Bladder of Urine, and Gall-Bladder ; Scales of the Teeth, &c.

D E S I D E R A T U M IV.

4. *To discover various Uses of the Motion of Dilatation and Contraction in the Air, by Heat.*

D d d d 2

A P P R O X I-

^v These Particulars are already mentioned in the Body of the Enquiry.

The History of CONDENSATION,

APPROXIMATIONS.

The Thermometer ; *Hero's Altar*^w ; the Organ made to play by the Sun's Rays ; and the Contrivance for imitating the ebbing and flowing of the Sea, and Rivers.

DESIDERATUM V.

5. *A Method of suppling the Limbs of Animals, by a proportionate Heat, and the Detention of the Spirit.*

APPROXIMATIONS.

The softening of Iron ; the softening of Wax ; and the business of Amalgamations. This regards the Restoration of Youth in old Age : for all Humectation, besides what proceeds from a Detention of the native Spirit, seems to be spurious, and of little Efficacy^x.

ADMONITION.

Conclusion.

We here propose but few *Desiderata*, with their *practical Hints* ; because the Subject is so general and extensive, that it rather serves to inform the *Judgment*, than direct to *Practice* y.

End of the History of Condensation and Rarification.

INSTAU-

^w See Sect. IV. 7.

^x See the *History of Life and Death*, passim.

^y Let it be observed that this is no more than a *Delineation, or first Draught, of the History of Condensation and Rarification*, that requires to be continued, amended, filled up with Instances, transposed and verified, according to the Directions of the second Part of the *Novum Organum* ; till the *Canons* become stable, and lead, without Error, to Practice ; till the *Desiderata* here mentioned may be readily supplied, or shewn to be impracticable ; and till the Doctrine and Axioms may fully inform, and securely conduct the Mind, in future Enquiries ; by way of a *general Opening and Introduction to Physics*.

INSTAURATION.

P A R T V.

Philosophia Prima :

O R, A

TEMPORARY STRUCTURE

O F

PHILOSOPHY,

Raised by the

Natural, unassisted Powers of the
Understanding ;

A N D O F

Service only till a genuine and pure A X I O M A T I C A L
P H I L O S O P H Y be procured,

According to the Directions of the

NOVUM ORGANUM.

T H E
A U T H O R ' S
P R E F A C E.

WE judge him to have been a beneficent Man, and a prudent Magistrate, who when asked if he had given his Citizens the best Laws he cou'd, replied, the best that they wou'd receive ^a. And, certainly, he who is not content with good Thoughts alone, which are little better than good Dreams; but also desires to obtain his End, and effect his Design, must not always chuse the best Things; but sometimes prefer the best of such as may be received.

But tho we earnestly desire to promote the Good of Mankind in general, as they are all Citizens of the World; yet we think ourselves not at Liberty to use this Legislative Power, or make this prudential Choice: and accordingly neither pretend to impose Laws upon the Understanding, nor upon Things themselves; but only as faithful Secretaries, receive and write down such Laws as are published by the Voice of Nature. And therefore, whether such Laws shall happen to please or displease, and so be received, or repeal'd by the Voice of Opinion, we are resolv'd to execute our Trust.

And indeed we conceive Hopes that there are at present, and will thro' succeeding Ages, arise, Men of Eminence, capable of receiving, procuring, and delivering the best Things of all; and solicitous in cultivating and bringing them to perfection: whence we are determin'd to continue our Endeavours after these better Gifts; opening the Fountains both of Things, and Uses; and on all sides searching out Indications of the right Ways.

But whilst we thus strenuously pursue the greater Matters, we do not disregard the less; especially as these are nearer hand, but those lie farther off: for we duly regard whatever may be of general Use;

V O L. III.

E e e e

and

^a The Saying of Solon, with regard to the Athenians.

and promote the common Good. And therefore, tho, in our own Opinion, we lay better Things before Mankind than either the ancient, or those at present receiv'd; yet we are far from lessening these latter in the publick Esteem: but desire that even these shou'd be improved, enlarged and priz'd as they deserve. For it is no part of our Intention, to lead all Men totally, or any of them immediately away from the Things at present authorized, and believed. But as an Arrow in shooting, whirls round its Axis, all the time of its progressive Motion; and thus helps itself forwards; so whilst we tend to our Mark, we desire to roll round in the Things now commonly known and received. And thus we candidly and ingenuously make use of the assistance of common Reason, and the vulgar Demonstrations; tho we disallow their sway, or absolute Authority: but, with the same right as the rest of Mankind, deliver such Things as we have discovered, and approved, by the ordinary Means: for such Things may, doubtless, have a great share of Truth and Utility ^b.

By this Procedure, however, we mean not, in the least, to derogate from what we have all along said, of the insufficiency of the unassisted natural Reason, and the Demonstrations of the Ancients; but only lend out these Things to the World for a Time, to accommodate those who, thro' a want of Abilities, or thro' multiplicity of other Affairs, have just Excuse for confining their Contemplations within the old beaten Paths and Provinces of the Sciences, or at least, within the Confines thereof; and again, to serve such as, according to our Indications and Directions, shall enter into, and pursue, our true Method of interpreting Nature: thus setting up for them Inns by the way, for their ease, support, and refreshment; whilst at the same time, we in some degree promote the Felicity of Mankind; and afford a large supply of Matter to such Minds as have a somewhat closer affinity and connection with Nature. Tho this we no way hope to do, on account of any extraordinary Talent, or any uncommon Reliance we have upon ourselves.

On the other hand, if any Person of a common Capacity, but of a ripe Judgment, wou'd lay aside the Idols of his own Mind, resolve to begin his Enquiries anew, and with Attention, Diligence and Freedom, converse among Realities, or the Facts and Experiments of Natural History; he might thus, doubtless, penetrate much farther into Nature, by the sole proper and genuine Powers of the Mind, and by his own mere natural Thoughts and Apprehensions, than by reading all

^b This Passage and the following regard the Author's new Method of Induction, and Investigation of the Forms of Things, as laid down and exemplified in the Second Part of his *Novum Organum*.

all the Authors that have wrote, or by indulging himself in abstract Contemplations, or by pursuing and repeating the most rigorous, and assiduous Disputations : and this tho he were not to use any of our Machinery, or Contrivances, to assist his Understanding ; nor was acquainted with the true form of Induction and Interpretation^c. We, therefore, hope that something of this kind may happen to ourselves ; especially as we have already had some Experience in the Business of Interpreting Nature ; which may probably correct and change the perverse Habit and Bent of the Mind^d.

This, however, must not be so understood, as if we required that Assent to our own Doctrines and Opinions, which we refuse to the Ancients : for we openly profess and declare, that we will by no means abide by the Things we shall here deliver ; whatsoever they may prove : and this purely to reserve every Thing, as it were entire, for our Secondary, Inductive and more perfect Philosophy^e.

We think proper in the Work itself, to deliver our Thoughts loose and free ; without binding them up into Method : because this Form best suits the young Sciences, that are but just sprouting a-new from their Roots ; and has no Tendency to build up an Art, by the cementing of Things together ; but leaves, as it ought for the present, every Subject unlimited, and open to farther Enquiry^f.

E e e e 2

A N.

^c As deliver'd in the *Novum Organum*.

^d Which it has to *idols*, abstract Speculations, Generals, &c. See the *Novum Organum*, pag. 351. &c.

^e Which was to make the *sixth Part of the Instauration*.

^f The Author appears to have made but little Progress in the *fifth Part* of his *Instauration* : For it is not certain that any of the few following Pieces, except the *Introduction*, were originally intended for the Place we have here assign'd them ; at least not till they had been farther improved, and enlarged : whence no true Judgment can be formed of the *Philosophia Prima* from any Thing left finished, or perfected, in order to it : but the Scope and Design thereof must be chiefly collected from the present Preface, and other Passages in the Author's Writings where it happens to be mention'd. See Vol. I. p. 15, and 510. Again, in the *Novum Organum*. Vol. II. Part I. Aph. 116, &c. Upon considering the whole Design, it shou'd seem that the Author here intended to have laid down the Materials of a more just and serviceable Philosophy, than the common ; and such as might be useful in forming the *Axiomatical Philosophy*, which he propos'd to begin in the *sixth* and last Part of his general Work, or GRAND INSTAURATION.

A N

E S S A Y

Towards a Scientific H I S T O R Y of

NATURAL PHILOSOPHY;

FROM THE

Primitive T I M E S to the P R E S E N T.

Deduced by Way of

EXPLANATION upon the *Ancient* FABLE OF CUPID ^c.

S E C T. I.

The P H I L O S O P H Y of *such as hold* ONE P R I N C I P L E of *all Things*.

I. **W** *Hat the Antients relate of Cupid, or Love, cannot coincide in the same Person. And indeed they made two Cupids, extremely differing from each other; the first being called the eldest of the Gods, and the second their youngest Son: but our present Business is with the former. The elder Cupid is said to be prior to all Things, except Chaos, which* *The Fable of the antient Cupid.*
is

^c This is an unfinished, posthumous Piece, published by Gruter among the *Scripta*; and does not execute half of his original Plan; which was to explain the whole Doctrine of all the ancient Philosophers, concerning the *first Principles of Things*; and set that obscure Affair in a genuine Light; that the grand Work of Experimental Philosophy might go on, without the Interruption of any fantastical Theory, Scepticism, or a Disbelief of the Senses. And tho the Author has left the Undertaking unfinished, yet there is enough done, to set even an ordinary Capacity in the way of executing it; which perhaps requires rather plain natural Sense, Diligence, and Application, than bright Parts, or a penetrating Genius.

is made coeval with him. He is introduced absolutely without Parent : but by Mixture with Cœlum, he is said to have begot the Gods, and every thing else. Some, however, relate that he was produced from an Egg, hatched by Nox. He has different Attributes assigned him ; as those of being always a Child, blind, naked, winged, and an Archer. His principal and peculiar Power is that of uniting Bodies. And the Keys of the Sky, the Sea, and the Earth, are said to be his^d.

Corresponds to
the Philosophy
of Democri-
tus.

2. This Fable seems, in the narrow compass of a Parable, to deliver a philosophical Account of the Principles of all Things, and the Origin of the World, not greatly differing from that of Democritus ; only the former appears somewhat more sober, exact, and pure. For tho Democritus was a very acute and industrious Philosopher ; yet his Contemplations run into Extravagance ; and did not each other sort with or sufficiently support themselves. And even the Points here couch'd in the Fable, tho somewhat more correct, are but such as may seem to have proceeded from the Understanding left to itself ; and not successively, or gradually assisted by Experience^e. And this we judge to be an Error that prevailed, even in the first Ages of the World.

The first Ex-
istence of Mat-
ter.

3. We must also observe, that the Things wrapt up in this Fable are but the Conclusions of human Reason, and the Dictates of the Sense, whose defective and ceasing Oracles are now justly rejected ; since better, and more certain Accounts are given us by Revelation. Chaos, therefore, which was coeval with Cupid, denotes a rude Heap, or Collection, of Matter : but the Matter itself, together with its Power, its Nature, and the Principles of Things, are shadow'd out in the Person of Cupid ; who is introduced without Parent, that is, without Cause ; for Causes are as the Parents of Effects. And it is common, in figurative Speech, to denote the Cause and Effect, by the Words Parent and Offspring. But for the first Matter, and its peculiar Energy and Action ; it could have no Cause in Nature : (for in assigning philosophical Causes we always except God) as nothing existed before it. Matter, therefore, had no Efficient, nor any thing better known or closer linked to Nature, than itself ; and consequently has neither Genus nor Form^f. And therefore, whatever this Matter be, together with its Power and Efficacy, it is a positive and surd Thing ; to be taken just as we find it : for it cannot be judged of by any previous Notion or pre-

^d See the same Fable in the Author's Piece de Sapiencia Veterum. Vol. I. pag. 568.

^e According to the Method delivered in the second Part of the Novum Organum.

^f Whence the Nature of Matter can never be understood by Man ; but we are obliged to take it, as our Senses represent it. And it might be for the advantage of Philosophy to do this, without indulging endless Speculations about its Cause, the Reality of its Existence, the Possibility of its thinking, &c. Instead whereof the proper Office of Philosophy is, to discover the Laws, the Motions the Modifications, the Transformations and Changes of Matter : but for knowing its Nature, or real Form, if it had any ; this would imply a Possibility in Man to create Matter, which involves a Contradiction. See Novum Organum, Part II. Aph. 4. and the History of Condensation and Rarefaction, pag. 505, 569, &c.

pre-conception. And if its *Modus* could be known ; this would not be from its Cause : as it is, next after God, the Cause of Causes, and itself without a Cause. For there is a true and certain Limitation of Causes in Nature ; and it would be as absurd and unphilosophical to require them, when we arrive at the ultimate Powers, and positive Laws of Nature ; as not to require them in Things of a subordinate kind. *Cupid*, therefore, is in the *Fable* wisely supposed to be *causeless*.

4. Nor is this an Affair of slight Consequence ; but of very great Importance : for Philosophy has been corrupted from no Quarter more than from this *Enquiry after Cupid's Parents* ; that is, from Philosophers not receiving and admitting the *Principles of Things*, as they are found in Nature, for a certain positive Point, upon the Attestation of Experience ; but they have rather derived and deduced them by the Laws of Disputation, or petty logical Arguments, mathematical Conclusions, vulgar Notions, and the like Excursions of the Mind, beyond all the Limits of Truth and Nature. A Philosopher, therefore, should constantly bear in Mind, that *Cupid* is Parentless ; to prevent the Understanding from turning aside to Vanity, and empty Speculation : because the human mind is extremely apt to run into these general Notions ; so as to abuse both itself and Things ; and whilst it endeavours to go forwards, comes back to Matters that lay nearer at hand. For as the Mind, by reason of its own Narrowness, is most accustomed to be moved by such Things as occur familiarly to it, and have a power at once to strike and enter the Imagination ; it happens that when it extends itself to those things which are most general in Experience, and yet will not rest satisfied in them ; but still endeavours after somewhat better known ; it falls upon such Things as have the most affected, or ensnared it ; and absurdly imagines that these are more demonstrative, and nearer approaching to *Causes*, than those Generals it was not content with [§].

5. So much for the first Existence, and native power of Matter : we come next to the *Modus* of the Thing. And this likewise is very obscure ; as the *Fable* elegantly denotes, by making *Cupid* proceed from an Egg hatched by *Nox*. The sacred Philosopher pronounces, that *God has made every Thing beautiful in its Season ; and given the World up to the Disputes of Men ; but that Man cannot find out the Works which the Lord has wrought, from the Beginning up to the End*. For the highest Law of Existence and Nature, which determines and runs thro' all the Changes of Things ; (here expressed by *the Works which the Lord has wrought from the Beginning up to the End*) or the Power imposed by God upon the primitive Particles of Matter ; from the Combination whereof proceeds all the Variety of Things ; may be seen darkly ; but can scarce be clearly comprehended by the Thoughts of Men. And this Fiction concerning the Egg of *Nox*, is aptly referred to the kind of Demonstration whereby *Cupid* ^h is brought to Light : for those Things which are concluded by Affirmatives, seem to be the *Births of Light* ;

§ Such is the Process of the Mind when it leaves Experience and Sense, to wander thro' the Maze of general, abstract Notions. See the *Novum Organum*, pag. 35, &c.

^h Viz. The Laws of Matter, and its Motions.

The Atoms of
Democritus.

Light; but those concluded by Negatives and Exclusions, are educed and forced, as it were, out of Darkness and Night¹. And thus *Cupid* is truly an Egg laid by *Nox*; as all the Knowledge we can have concerning the original Law imposed upon Matter, proceeds by Exclusions and Negatives. But all Proof made by Exclusion, is only a kind of Night, with regard to what is included. Whence *Democritus* did well to declare that his *Atoms*, or Seeds, and their Virtue, were like no kind of Thing which could fall under the Senses; and pronounced them perfectly invisible, secret, and concealed by Nature². *Atoms*, therefore, are neither like Sparks of Fire, Drops of Water, Bubbles of Air, Grains of Dust, nor the fine part of Spirit or *Æther*; nor is their Virtue and Form either Gravity or Levity, Heat or Cold, Density or Rarity, Hardness or Softness, as in the case of larger Bodies; since all these, and the like Properties, are compounded and made up of several. Neither, again, is the natural Motion of Atoms, that of Descent or Ascent, that of Expansion and Contraction, that of Expulsion and Connexion, that of Rotation, or any other Motion of the larger Bodies, simply. Yet in the Bodies of these Atoms are the Elements of all Bodies; and, in their Motion and Virtue, reside the Beginnings of all Motions and Virtues. But here, in the Motion of Atoms compared with the Motion of larger Bodies, the Philosophy of the *Fable* seems different from that of *Democritus*; who does not only disagree with the *Fable*, but also with himself; so as almost to speak contradictory in what he farther delivers upon this Subject. For he ought to have attributed a Heterogeniety of Motion to his Atoms, no less than a Heterogeniety of Substance and Energy: but he has singled out two Motions from the Motions of the larger Bodies, *viz.* that of the Descent of heavy ones, and the Ascent of light ones, and communicated them to his primitive *Atoms*: whereas the *Fable* throughout maintains as a Heterogeniety, and Exclusion, as well in Substance as in Motion.

The End of
Exclusions.

6. The *Fable* farther intimates, that there is some End and Measure of these Exclusions; or that *Nox* does not continue brooding for ever. And certainly it is the Property of God alone, when we enquire into his Nature by means of the Senses, not to need Exclusions for determining Affirmatives³. But the case is different in Men; as after due Exclusions and Negations there is somewhat affirmed, determined, and excluded, to them; like an Egg laid after a timely Brooding and Waiting. And not only the Egg is thus laid by *Nox*; but also the Person of *Cupid* is hatched from the Egg: that is, not only a certain Notion of the Thing may be drawn and extracted from

¹ See the *Novum Organum*, Part II. Sect. I. Aph. 4, &c.

² ——— Neque sunt igni simulata, neq. ullæ
Præterea rei, quæ corpora mittere possit
Sensibus, & nostros adjectu tangere tactus.

Again.

Atq; primordia gignundis in rebus oportet
Naturam clandestinam cæcamq; adhibere;
Emineat ne quid, quod contra pugnet & obstat.

³ The Forms of Things lying open to him. See *Novum Organum*, Part II. Aph. 15.

from Ignorance, but also one that is distinct and clear ^m. And thus much for that kind of *Demonstration* concerning the first Matter; which is a Demonstration suited to Men, and, in our Judgment, corresponds extremely to the Sense of the *Fable*.

7. We next proceed to *Cupid* himself, or the first Matter, together with its Properties; which seem enveloped in Darkness and Night; to find what Light the *Fable* will afford us herein. But we are well aware that Opinions of this kind enter the Mind with difficulty, and seem almost incredible, or shocking to the Sense and Thoughts of Men: yet we may plainly perceive, that some Attempt has been made in this way, by the *atomical Philosophy* of *Democritus*; which proving subtle, penetrating deep into Nature, and lying remote from common Notions, was looked upon as a childish thing by the Vulgar; and being also toss'd about by the Winds of other Philosophies, which were better suited to vulgar Capacities, it is thus in a manner extinguished and lost. And yet *Democritus* flourished with great Admiration and Applause, in his own Times; and by reason of his universal Knowledge was called *Pentatblus* ⁿ; and by the general consent of other Philosophers, he was allow'd a great *Naturalist*; so that he obtained the Name of *Magus* ^o. Nor could the violent Contests and fierce Opposition of *Aristotle*, (who, with the *Ottoman* Temper, thought his own Philosophy would never reign secure, till he had murder'd its Competitors; and who tells us plainly, that he was determined to cut off all future Occasion of doubting;) nor even the Majesty, and solemn Gravity of *Plato*, totally abolish this Philosophy of *Democritus*: but whilst the Doctrine of *Aristotle* and *Plato* were, with great Noise and pedantical Pomp, celebrated and re-sounded in the Schools; this Philosophy of *Democritus* was held in great esteem by the wiser sort, who enter'd deep into the silent and less obvious kind of Contemplations. 'Tis certain, that in the Times of the *Roman* Learning, the Philosophy of *Democritus* was still in being, and admired; for *Cicero* every where makes mention of him with great Encomiums; and *Juvenal*, not long after, gives him a high Character, after the manner of the *Poets*; who usually speak the Judgment of their own Times ^p. It was not, therefore, *Aristotle* or *Plato*, but *Genfericus* and *Attila*, and the *Barbarians*, that ruined this Philosophy. And indeed when all human Learning was shipwreck'd, those Planks of *Aristotelian* and *Platonic* Philosophy were preserved, and handed down to us, as a light and tumid Matter; whilst the more solid parts of Knowledge sunk, and are almost buried in

*The History of
the Democrati-
cal Philosophy.*

VOL. III.

F f f

oblivion.

^m The whole of this Explanation means no more than the *Method of investigating the Forms of Things*, as delivered and exemplified in the second Part of the *Novum Organum*. See *Aph.* 10, 11, 12, 13, &c. of that Part.

ⁿ As if he had understood the whole Circle of Arts and Sciences: *Pentatblus* literally signifying a Person who performs the five Exercises of Running, Leaping, Dartsing, Wrestling, and throwing the Quoit.

^o Or *Natural Magician*, in the honourable Sense of the Word.

^p — Cujus prudentia monstrat

Magnos posse viros, & magna exempla duros,
Verecun in patria, crasseque sub acre, nasci.

The Origin of
scholastic
Forms and
Ideas, in
Matter.

oblivion. But the Philosophy of *Democritus* seems to us worthy of being preserved from Neglect; especially since, in numerous Particulars, it agrees with the venerable Doctrine of the earliest Ages¹.

8. In the first place therefore, *Cupid* is described as a Person, to whom are attributed *Nakedness, Infancy, Wings, Arrows*, and other Things; to which we shall speak severally in order². But previous thereto it must be observed, that the Ancients laid down their *first Matter*, which they made the Principle of all Things, as a Matter formed and endowed with Properties and Virtues; and not as an abstract, potential, and uninformed Mass. And certainly such a despoiled and passive Matter, seems to be nothing more than a mere Fiction of the human Mind; arising from hence, that the Mind gives the greatest Strefs to the Things it imbibes the strongest, and wherewith it is most affected: whence it comes to pass that what Men usually call *Forms*³, may seem to have a truer Existence than either *Matter* or *Action*; because Matter is a dark, and Action an unstable Thing: and again, because Matter is not so strongly impressed upon the Mind, nor Action always inherent: whilst these Phantoms of *Forms* are, on the contrary, thought to be both manifest and constant; insomuch that the first common Matter is look'd upon but as an Accessary or Support; and all Action but as an Emanation, of the *Form*: so that the preheminance is absolutely attributed to *Forms*. And this seems to have been the Origin and Foundation of the Kingdom of *Forms* and *Ideas* in Things; viz. the superaddition of a certain phantastical and imaginary Matter. These phantastical Notions have been fed by Superstition; which is generally the attendant of Error and Extravagance. Abstract Ideas have also been introduced, and their Dignity exalted, with so much Confidence and Authority, that the dreaming part of Mankind has, in a manner, prevailed over the waking. But these Phantoms now appear to be almost vanish'd; only certain Writers of our Time, have endeavoured to prop them up, as they were tumbling, and to fix them upon their Basis again; but doubtless the Undertaking is more adventurous than useful. And were it not for Prejudice, every Man would soon perceive how irrational it is to make abstract Matter a Principle: for tho they assert the actual Existence of separate *Forms*; yet no one asserts the separate Existence of Matter; not even of those who make it a Principle. And it seems absurd, preposterous, and incongruous to the Enquiry after Principles, to raise Essences from phantastical or notional Things. For the Point is not how we may most commodiously receive into our Thoughts; or distinguish the Nature of Essences; but what are in reality the primary and

¹ See the *Novum Organum*, Part I. *Aph.* 71, 72, &c.

² The Piece, we before observed, is imperfect, so that only the first of these Attributes of *Cupid* is here spoke to; but what is wanting may, in some measure, be supplied from the Author's other Piece, *de Sapientia Veterum*; especially where the Fables of *Cupid*, of *Cælus*, and of *Pan*, are explained. This philosophical Comment upon the *Fable of Cupid*, was intended to be succeeded with another upon the *Fable of Cælus*, which would have rendered the Design complete.

³ Viz. Abstract or *Aristotelian Forms*; not the *Forms* of the Author, which are determined in Matter. See *Novum Organum*, Part II. *Aph.* 2, 4, 10, 13, 15, &c.

and most simple Essences; from which all other Things proceed: for the first Essence must no less really exist, than those which flow from it; but rather more: since this is self-existent; whereas the others only exist by its means *.

9. Indeed, what we find said about abstract Matter, is not much better than to assert that the World, and all Things, are made of *Catagories*, and such logical Notions, as if these were Principles: for it is almost the same to say, that the World consists of *Matter, Form, and Privation*; as that it consists of *Substance and contrary Qualities*. But nearly all the Ancients, as *Empedocles, Anaxagoras, Anaximenes, Heraclitus and Democritus*, tho they differed in other Respects about the *first Matter*; yet agreed in this, that it was an active *Matter*, of some *Form*, that had a Power of dispensing its *Form*, and a Principle of Motion within itself. Nor can any one possibly think otherwise, who does not plainly desert Experience. All these Philosophers, therefore, submitted their Minds to Things.

The absurd Notion of abstract Matter.

10. But *Plato* subjected the World to Thought; and *Aristotle* subjected even Thought to Words; the whole Bent and Study of Men then tending to Dispute, Discourse and Reasoning; with an utter neglect of all severe and rigorous Enquiry after Truth *. Whence the Doctrines of this kind are rather to be censured in the Lump, than severally confuted; as being the Doctrines of such Men as chose to talk a great deal, and understand but little. And to say the Truth, this *abstract Matter* is entirely a Matter of Dispute; but not the *Matter of the Universe*. And he who wou'd philosophize in a due and proper manner, must dissect Nature; but not abstract her, as they are obliged to do, who will not dissect her. And thus we must necessarily lay down, (1.) a *first Matter*, join'd with (2.) a *first Form*, and also (3.) with a *first Principle of Motion*, as it is found. For the Abstraction of Motion has also produced infinite phantastical Conceits, about Souls, Life, and the like; as if these cou'd not be owing to *Matter and Form*; but must needs depend upon separate Principles of their own. These three Things shou'd not be separated, but only distinguished; and *Matter*, whatever it is, must be laid down so endow'd, prepared and form'd, that all Virtues, Substances, Actions, and natural Motions may be the Consequence and Emanations thereof. And let no one apprehend that Things will, upon this footing, languish and become torpid; or that the variety we find in the Universe cannot hence be explain'd: for we shall shew the contrary hereafter †.

The true physical Notion of a first Matter.

11. And that the *first Matter* has some *Form*, is indicated by the *Fable* in making *Cupid* a Person; so that tho the whole Mass of Matter were at first uninform'd and rude; which is represented by *Chaos*; yet *Cupid* is form'd and personified. And this Account excellently agrees with sacred Writ; where we read, *that God in the beginning created*, not a confused, uninform'd

That first Matter has a Form.

F fff 2

Mass

* See the true Doctrine and Investigation of Forms explained in the *Novum Organum*. Part II. Sect. I. throughout.

† Suppose according to the Rule of the *Novum Organum*.

‡ See below, § 14, 15, &c.

Mafs of Matter, but *Heaven and Earth*. To this Account, however, is annex'd some Description of the state of Things before the six days Work ; where distinct mention is made of Earth and Water ; which are Names of Things already formed ; yet the Mafs still remain'd uninform'd, in its whole.

Matter naked. 12. But tho the Fable introduces *Cupid* personified, it still leaves him naked : and therefore, next after those who wou'd introduce *abstract Matter*, they err, in the contrary extreme, who introduce it clothed. Somewhat of this Subject we have touch'd above, in laying down such Demonstrations as are suitable to a *first Matter* ; the Heterogeneties introduced wherein, we have also spoke to, in some respect ; but this is the proper place for treating them. We must, therefore, here enquire, among such as place the Principles of Things in Matter formed, who they are that have attributed a native, naked Form to Matter ; and who have introduced it cover'd and clothed.

The Sects that have super-added Clothing to Matter.

13. There are four different Opinions relating to this Affair. The *first* is that of those who assert some one Thing to be the Principle of all Things ; but constitute a diversity of Substances in the indeterminate, and dispensible Nature of that Principle. The *second* is that of those who make the Principle of Things to be one fix'd and invariable Substance ; and derive the Diversities of Bodies from the different Magnitudes, Figures, and Positions of this Principle. A *third* sort constitute several Principles of Things ; and place the Diversity of Bodies in the tempering and mixing thereof. And the *fourth* sort are those who make infinite, or at least, numerous Principles of Things ; but suppose them specified, and fashioned : and these have no occasion to invent any Thing else for giving a manifold variety ; as they have already split and divided Nature from the beginning. But of these four Sects we judge that only the *second* exhibits *Cupid* native and undress'd. For the *first* introduces him as it were *veiled* ; the *third* *vested* ; and the *fourth* *cloak'd*, or wrapt up in a *Mantle*, and almost masked. We shall speak a little to each of them, the better to explain the *Fable*.

The Earth not made the Principle of Things.

14. (1.) And *first*, we find none of those who constitute one Principle of Things, that affirm this Principle to be the *Earth* : for the quiet, languid and unactive Nature thereof, passively receiving the Influences of the Heavens, of Heat, and of other Things, has hindered such a Thought from entering into any ones Mind. And yet the earliest *Mythology*, or *Wisdom of the Antients*, places *Terra* next after *Chaos* ; and makes it first the Parent, and then the Consort of *Cælum* : from which Conjunction all Things proceeded. But this is not to be understood, as if the Antients ever made the *Earth* a Principle of Beings ; but only a Principle, or rather the Origin, of a Structure, or System, of Things. We shall therefore refer the Prosecution of this Affair to the following Fable of *Cælum* ; under which we propose to enquire into the Origin of Things : this latter being an Enquiry posterior to that of *Principles* x.

15. But

x This Fable of *Cælum*, was not, as we above observed, explained in the large manner here propos'd ; but stands, in a contracted View, at the Entrance of his *Piece de Sapiencia Veterum*. See Vol. I. pag. 550.

15. But *Thales* makes *Water* the Principle of all Things, from observing that Matter was chiefly dispensed out in Moisture, and Moisture dispersed in Water. *Water made the Principle of Things, in the Philosophy of Thales.* And he judged it not improper to lay that down for the Principle of Things, in which their Virtues, Powers, Vigour, and especially the Elements of their Generation Increase and Repair, are principally found. Thus the Seed of Animals he observed is moist; and that the Seeds and Kernels of Plants, (so long as they continue in a growing state and unexhausted) are soft and tender. Metals likewise melt, and appear but as concreted Juices of the Earth; or rather as certain Concretions of the Waters of the Mine². The Earth itself is made fruitful, refreshed and recruited by Rains, and Rivers: and Earth and Mud may seem to be only the Fæces and Sediment of Water. Air appears still plainer to be but an Expiration, and Expansion of Water³. And even Fire itself cannot be supposed to exist, or be fed and supported without Moisture. For that fat Moisture, which is the Support and Life of Flame, and Fire, may seem but a certain Ripeness and thorough Concoction of Water⁴. Again, the Body and Bulk of Water is diffused, as a common Matter, throughout this lower World. The Earth is every where watered and encircled by the Ocean. There is an immense quantity of sweet Water in the subterranean Regions; whence Fountains and Rivers, like so many Veins in the Body, convey Water over the Surface, and thro' the Entrails of the Globe. In the Regions of the Atmosphere there are prodigious Collections of Water, and Vapour, that seem to supply a new Fund thereof; and recruit, refresh and enliven all the Waters, and the Ocean below. Nay, this Philosopher went so far, that he even supposed the celestial Fires were continually fed with these Waters and Vapours; as conceiving they cou'd not subsist without Aliment, nor derive it from any thing else. And for the figure of the particles of Water, he saw by Drops, that it was round, or spherical, like the Universe. He also observed that Water had an Undulation, and this even in Air and Flame: and lastly, that it had a due Disposition to Motion, neither too languid nor too quick; and that the Generation of Fish and Fowl was extremely numerous⁵.

16. But *Anaximenes* made the *Air* to be the sole Principle of all Things. *Air made the first Principle by Anaximenes.* For if Bulk is to be regarded in constituting the Principles of Things, *Air* seems to possess a very large part of the Universe. And if there be no separating *Vacuum*, or if we reject that superstitious Notion of the heterogeneity betwixt the celestial and sublunary Bodies, the whole space that reaches from the Globe of the Earth to the extremity of the Heavens, and is neither occupied by Stars nor Meteors, may seem to be fill'd with an aerial Substance.

² This is a Matter of deep Speculation and Enquiry. See *Becher's Physica Subterranea*.

³ See the Author's *History of Winds*, passim.

⁴ Some of Mr. *Boyle's* Experiments appear to confirm, or strengthen, this Supposition. See his *Sceptical Chémist*. See also *Becher* and *Stahl*.

⁵ And thus the Point might seem, in a manner, discovered and settled by an Induction of Particulars. But Inductions of Particulars made on one side only, are very fallacious; and in no respect to be trusted. And yet most Philosophies are of this kind. See the *Novum Organum*, passim.

stance. But the terrestrial Globe is no more than a Speck or physical Point compar'd with the Heavens, that surround it: and in the Æther itself, how small a Portion is spangled with Stars? Near to the Earth they appear but very few; and higher up, tho' their Number indeed be great; yet all the space they possess seems inconsiderable with respect to the interstellar Regions; insomuch that they may all appear as it were floating in an immense Ocean of fine *Air*, or Æther. On the other hand, there is a large quantity of *Air* and *Spirit* lodged in the Water, and Caverns of the Earth; from whence the Waters may be said to receive their Fluidity. Sometimes also the *Air* and *Spirit* swell or expand themselves; and may thus escape thro' the Pores of the Earth: but Tremblings and Earthquakes are esteem'd evident signs of Wind and *Air* pent up in the Earth's Bowels.

*The Disposition
of Air for
constituting
a first Prin-
ciple.*

17. And if a certain middle Nature be required in Principles, to render them susceptible of such a vast variety, this Property seems to be found perfect in the *Air*. For the *Air* appears to be the common Link and Cement of Things; not only because it is every where at hand, and ready to succeed and fill up Vacuities; but much more because it seems to be of a neutral, indifferent, and indeterminate Nature. For *Air* is that which receives and transmits Darkness, Light, and all the Tinctures and Shades of Colours and Diminutions of Light; and by its curious undulating Motion distinguishes Tones, Voices, the Notes of Musick, and even articulate Sounds; and without Confusion, distinctly conveys all the Variety of Smells, not only those general ones of sweet and fetid, dull and brisk, &c. but also the proper and specific Odours of Things, as of each particular Flower, and all the odorous Tribe of Bodies. Again, the *Air* remains neutral and indifferent to those great and powerful Qualities of Heat and Cold, Dryness and Moisture; and in it are at once suspended and convey'd aqueous Vapours, unctuous Exhalations, the Spirits of Salts, the Fumes of Metals, &c. all separate and unconfounded. Lastly, *Air* is the Fluid wherein the Rays and Influences of the celestial Bodies, and the more latent Agreements and Disagreements of Things, secretly reign and act; as if the Atmosphere were a second Chaos, wherein the Seeds of so many Things have their Effects, their Courses, Trials, Wanderings, and Changes.

18. In short, if we consider the generating or vivifying Power in Things, which may lead to, and manifest their Principle; here again the *Air* will appear excellently qualified: insomuch that the Words *Air*, *Spirit* and *Soul* are sometimes confounded, and used for the same Thing; and this not without Reason; as Respiration may seem to be an inseparable Attendant upon all perfect states of Life; so that, excepting the first Rudiments of Life in Eggs, and Embryos, even Fish require the use of *Air*, and are suffocated for want of it, when the Surface of the Water remains long frozen. And Fire itself, unless animated by the *Air* around it, dies, and may seem to be nothing more than *Air* ground together, irritated, and kindled; as on the other hand, Water may seem to be *Air* condensed and shrunk within itself. Lastly, the Earth may perpetually exhale *Air*; so that *Air* need not pass thro' the state of Water in order to obtain its natural Form.

19. *Heraclitus*, with greater Subtily, but less Probability on his side, *Fire made the* makes *Fire* the Principle of all Things; not looking out for a middle *first Principle* Nature, which is usually vague and corruptible; but for a high and perfect one, which might prove a certain limit to Corruption and Change. For he saw there was a great variety and disturbance in solid and consistent Bodies; which may be organical, or like Machines, that receive innumerable variations even from Figure; as appears in the Bodies of Plants and Animals. And even such of these Bodies as are not organical, will, if narrowly look'd into, be found very dissimilar. For there is a great dissimilarity between those parts of Animals which are call'd similar; such as the Brain, the crystalline Humour, the albuginous Coat of the Eye, Bone, Membrane, Cartilage, Nerve, Vein, Flesh, Fat, Marrow, Blood, &c. And so again among the Parts of Vegetables, as the Root, Bark, Stem, Leaf, Flower, Seed, &c. Fossils are certainly not organical; yet appear variously mix'd in one and the same Species; and exhibit a very copious variety in respect of one another. Whence this extensive Foundation of Diversity in Bodies, and this large Apparatus, seems to be laid in a solid and consistent Nature.

20. But in the Bodies of Liquors there seems to be no organical Structure. For there appears to be no Animal or Plant, in a Body merely fluid: so that this most extensive variety is denied to, and cut off from the Nature of Fluidity. It however remains possess'd of a considerable variety, as is manifest from so large a diversity of fusible Bodies, Juices, distill'd Liquors and the like. But the point of Variety is reduced to a much narrower Compass in the Mass of *Air*, and pneumatical Bodies; and obscured with a promiscuous similitude of Things. 'Tis certain that the difference of Colours and Tastes, whereby Liquors are sometimes distinguish'd, is here absolutely wanting; but the impression of Smell, and some other Things remain; tho' but transiently, confusedly, and in a less adhesive manner: so that, universally, the nearer Bodies approach to the nature of Fire, the more they lose of their variety. And after they once put on the nature of Fire, in a pure, rectified state; they lose all that was organical, all their distinguishing Properties, and all their dissimilarity. And here Nature seems to meet, and unite, as it were, in one pyramidal Vertex; and to have attain'd the ultimate end of its peculiar Action. Whence this Philosopher call'd *Inflammation*, or *Ignition*, by the name of *Peace*, because it settled and quieted Nature, or reduced her to an Uniformity; but Generation he call'd by the name of *War*, because it produced multiplicity and variety. And in order to give some Explanation how this was brought about, or how Things shou'd from Variety be reduced to Uniformity; and from Uniformity to Variety; like the ebbing and flowing of the Tide; he thought proper to make Fire condensable and rarifiable: but so that its Rarification, in ascending towards a fiery Nature, shou'd be the direct and progressive action of Nature; but the Condensation, a kind of Retrogradation, Deser-tion, or falling back from Nature: and both these he thought happen'd by a certain Fatality at certain Periods, in the general Mass of Things: so that at one time or other, the World itself, when its Period was run, shou'd be

be set on fire, and afterwards renewed; and so pass thro' successive Revolutions of Burning and Regeneration, to Perpetuity.

21. And if we attentively look into the remaining historical Scraps and Fragments of this Philosopher's Doctrine, he will be found to have made the *Burning* and *Quenching* happen in a different Order. For in the Series of Burning he differed not at all from the common Notions upon that Head; making the Progress of the Rarification and Expansion, to be from Earth to Water, from Water to Air, and from Air to Fire: but in the descending Scale he has perfectly inverted the Order; and asserted, that Fire, by its Extinction produces Earth, or certain Fæces or Ashes; that these Ashes conceive and collect Moisture; whence there ensues a Flood of Water; which again shall emit and breathe out Air: so that the change from Fire to Earth shall be sudden and hasty, not gradual.

*The Clothing
of Cupid.*

22. And these, or perhaps somewhat better, were the Thoughts of those who constituted some one Thing the Principle of all others; considering Nature simply, and not contentiously. And they are to be commended for giving *Cupid* but a single Garment; which is the next degree to leaving him naked; especially since this Garment; as we before observed, is but a kind of a fine Veil, not wove gross and thick. By the *Clothing of Cupid* we understand the attributing of any *Form* to the *first Matter*, that may be asserted substantially homogeneous with the *Form* of any one secondary Essence. And as to the Assertions above laid down, from three eminent Philosophers of Antiquity, with regard to *Water*, *Air*, and *Fire*, it is easy to confute them severally; the Foundations they rest on being not firmly laid: but as there appears no reason for discussing each Point by itself, we shall only consider what they have said in the general.

*The Errors of
the ancient
Philosophers, in
laying down
their Principles.*

23. First therefore, these ancient Sages seem in their *Enquiry after Principles*, not to have proceeded in any very exact manner; but only from amongst apparent, obvious and manifest Bodies, to have sought out for the most excellent, and to have constituted what they thought so qualified, the *Principle of all Things*; and this by the way of Eminence, not in the way of precise Truth and Reality: for they imagined that such a pre-eminent Nature was alone worthy to be called what it appears to be; but for other Things they conceived them to be this same *Nature* at the Bottom, tho' it did not appear: whence they may either seem to have spoke figuratively, or else like Men under some Incantation or Prejudice; wherein the stronger Impression draws every thing to itself. But a true Philosopher must be equal and indifferent to all Particulars; and lay down such *Principles* of Things as shall agree even with all the smallest, least frequent, and most deserted or unregarded Natures; and not only with the greatest, the most numerous and most powerful. For altho' Men principally admire such Things as occur most strong and lively to themselves; yet the Bosom of Nature is open to all Things.

24. But if they held their *Principles*, not by way of Eminence, but in Simplicity; they certainly seem to have fallen upon a very hard Metaphor, or Figure of Speech, which renders their Positions plainly equivocal;
since

since what they assert cannot be truly said of natural *Fire*; of natural *Air*; or natural *Water*; but must be understood of certain phantastical and notional Things, which retain those Names, without the Signification. They also seem driven to the like distress with the Assertors of *abstract Matter*: for as these absolutely introduce a potential and phantastical Matter; the former do it likewise in part. They also, in some respect, lay down a formed and actual Matter for their *Principle*; but in other respects make it only potential: yet they seem to gain nothing by thus asserting one single *Principle*, more than those who assert *abstract Matter* for their *Principle*; except in this, that they produce an Object for the human Understanding, or a Thing whereon the Thoughts may dwell and be more fixed: so that the Notion of their *Principle* proves somewhat fuller; whereas all those of the rest are abstruse and harsh. The truth is, *Predicaments* had not at that time mounted the Throne; so as to conceal the Principle of *abstract Matter*, under the guard and custody of the *Predicament of Substance*. And therefore no Man durst then attempt to feign, or conjure up, any perfectly phantastical Matter; but they delivered their *Principles* according to the Evidence of Sense; and made them some real Being: tho' indeed they took a liberty of dispensing it out in a phantastical manner. For they neither found, nor could invent, by what Appetite or Incitement; by what Method, Process, or Inducement; their Principle should degenerate from itself; and again return to its Nature. But as there appears, thro' the Universe, such Armies of Contraries, in point of Density, Rarity, Heat, Cold, Transparency, Opacity, Animation, Inanimation, and numerous other Properties; which oppose, deprive and destroy each other; to conceive that all these should flow from some one certain *Fountain of a real material Substance*, and yet not shew in what manner it happened, may seem like giving into a lame and benumbed Theory, and deserting the Enquiry. For if the Fact itself be evident to the Senses, it must be admitted; tho' the manner of it remains concealed and unknown. On the other hand, if any probable and adequate Solution should, by the force of Reason, be discovered, perhaps some of the Appearances might be given up: but it can never be required that we should assent to those Things, the Existence whereof is neither manifest to the Senses, nor the Explanations of them rendered probable by Reason.

24. Again, if there was any one *Principle* of all Things, it should have a certain visible Mark, or a kind of Superiority and Preheminence in all Things; at least no principiated Body should be found directly opposite to its *Principle*. Nay, such a Principle ought to appear in the midst of Things, that they might commodiously participate thereof, and be diffused around it: but there is nothing of this kind found in their *Principles*. For the Earth, which is cut off and excluded from the Honour of a Principle, seems to receive and cherish Natures that are opposite to the three above-mentioned Principles. Thus to the noble and shining Nature of Fire, it opposes the Natures of Rest and Opacity; to the Rarity and Softness of Air, it, in like manner, opposes Density and Hardness; and to the Humidity and flowing Nature of Water, it opposes Dryness, Asperity,

Rigidity, and Fixedness : nay, the Earth also possesses the middle Place, as if it had thrust away the rest.

25. Lastly, if there was one single *Principle of all Things*, it ought to contribute equally as well to the Generation as to the Dissolution of them : for it is the Nature of a Principle, that Things should be resolved into it, as well as that Things should be generated from it. But this is not here the case ; since *Air* and *Fire* seem unfit to afford the Matter of Generation ; and are rather prepared to receive the Resolution of Things. *Water*, on the contrary is generative and alimential : but more averse and unfavourable to Resolution or Restoration : as would plainly appear, if Rain were to cease for any long time. And even Putrefaction itself, no way reduces Things to crude and simple Water. But the greatest Error they have committed, is in making their *Principles* perishable and corruptible : for this they do when they introduce such a Principle as quits and forsakes its Nature in Composition ^a. But we shall presently have occasion to press this Argument farther, in speaking to the third kind of Philosophers ; who make several *Principles* of Things.

S E C T. II.

The Philosophy of those that maintain more than one PRINCIPLE of all Things.

I. **T**HE Philosophers that maintain *several Principles* of Things, may seem to have more strength than the former : they certainly have more Prejudice ; and therefore we shall consider their Opinions, not together in the Lump, but each of them separate. We must observe the Distinction already made, betwixt those who assert *several Principles*, and those who make them infinite ; the latter will come properly under the *Fable of Cælum* : at present we are concerned only with the former.

*The Philosophy
of Parmenides
and Teleseus.*

2. Among the Ancients, *Parmenides* asserted *two Principles of Things* ; viz. *Fire* and *Earth*, or *Heaven* and *Earth* : for he maintained that the Sun and Stars were pure limpid Fire ; not degenerate as it is with us, where it appears like *Vulcan* precipitated head-long from Heaven to Earth, and become lame with the Fall. This Doctrine of *Parmenides* has been renewed in our time by *Teleseus*, a Man well versed in the *Paripatetical* Reasonings ; (if those were of any significance) so as to retort the Arguments of that Sect upon themselves : tho he is entangled with his own Positions ; and seems better at pulling down, than at building up. We have only a very slender and scanty History of the Discoveries of *Parmenides* : but the Foundations of an Opinion like his, are plainly laid in the Book that *Plutarch* wrote of the *Primum Frigidum* ; which seems taken from some other ancient Treatise, extant at that time, but now lost : for it contains several Things of greater

^a Nam quodcumque suis mutatum finibus exit,
Continuo hoc mors est illius, quod fuit ante.

greater subtilty and strength than are to be found in the original Works of that Author. And this perhaps it was that gave *Teleseus* the Hint, and Courage to lay hold of the Doctrine, and strenuously labour it in his own *Essays upon the Nature of Things*.

3. The Positions of this Sect run thus^b. They assert, (1.) that *Heat* and *Cold* are the *first Forms*, or the first active Beings, and therefore the primitive Substances; and yet that they have an incorporeal Existence, supported by a passive potential Matter, that may give them a corporeal Bulk, equally susceptible of both Natures, tho' itself be actionless. (2.) That Light is a Pullulation, or springing forth of dissipated Heat, multiplied and become strong and sensible, by collection. (3.) That Rarity and Density are but Textures, and as it were the Weavings of Heat and Cold; and that from this weaving or opening by Heat, and contracting by Cold, Bodies have a disposition or indisposition to Motion. (4.) That therefore there are four co-essential Natures; viz. *Heat, Light, Rarity, and Mobility*; with their Opposites, *Cold, Darkness, Density, and Immobility*. (5.) That the Seats of the former are in the Heavens, the Stars, and particularly in the Sun; but of the latter in the Earth. (6.) That the Heavens having an absolute and entire Heat, on account of their vastly rarified Matter, are most violently hot, shining, thin and moveable; but that the Earth, on the contrary, from its entire, or undiminished Coldness and most concentrated Matter, is extremely cold, dark, dense, perfectly immoveable, and absolutely averse to Motion, &c. &c. &c.

4. Such are the Positions of *Teleseus*, and perhaps also of *Parmenides*, with regard to the *Principles of Things*. And certainly they might appear more true, if there were no such Thing as Man in the World, nor any mechanic Arts to torture, vex and work upon Matter; or if the World was to be simply considered as a bare Structure, with regard to nothing but itself. For this Philosophy looks more like the Philosophy of a Shepherd, than of a Naturalist; or more like that of a bare Observer, than of an Operator; and considers the World calmly, and at leisure; or as in a State of Inactivity: whence it is tolerable, as a mere *System*; but treats the Business of *Principles* in a very negligent and unskilful manner. It also commits a great Error in the way of a System; by making such an one as may seem eternal, without supposing a *Chaos*; or any Changes and Revolutions in the great Structure of Things. For whatever Philosophy thus fashions; lays down, and establishes a System, without making it rise from a chaotic State, seems but light, or hypothetical; and indeed discovers a narrowness of Mind. For whoever philosophizes according to Sense, must assert the Eternity of Matter; and deny it to the World, such as it now appears: which is a Point well observed by the Wisdom of the earliest Ages; and, what approaches near to it, the Philosophy of *Democritus*. And the same

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^b The Author here proceeds to enumerate, in a candid manner, the particular doctrinal Points, maintained by *Teleseus*; which are exceeding numerous; but at present generally exploded: we have therefore singled out a few of the principal, for a Taste; tho' these, no more than the rest, are supportable upon his *Principles*.

is confirmed by the Scripture Account ; the difference consisting principally in this, that the Scripture ascribes the existence of Matter to God ; whereas the other Accounts wou'd make it self-existent. For there seem to be three Particulars known by *Faith*, with relation to this Affair ; viz. (1.) That Matter was created out of Nothing ; (2.) That a System was produced by the omnipotent Word ; or that Matter did not form itself out of *Chaos*, into the Structure we now see ; and (3.) That this Structure before the Fall, was the best that the Matter at first created was capable of. But other Philosophies reach'd not so far as to any one of these Points ; their Patrons having an abhorrence of a Creation out of nothing ; and conceiving the Structure of the Universe produced after many Revolutions, Essays and Endeavours of Matter ; whilst they do not concern themselves about ranging it in the best manner ; as they make the Structure but perishable and variable. In these Particulars, therefore, it were better to rest upon the Foundations of *Faith* : but more of this in the Fable of *Cælum*, to which it properly belongs ^c.

*The Principles
of Telestius
improveable.*

5. As to the *Principles of Telestius* ; he might have considerably improved his second, viz. that of *Cold* ; as he lays it down not for a privation of Heat, but as an independent, active Principle, the rival of *Heat*. And as we desire to favour all the Discoveries that can any way be made in Nature ; and wou'd give to every one of them their due weight ; he might have proceeded to shew the Action of *Cold* upon Matter, as he has done that of *Heat*, in the following manner. The Seat of Cold is fix'd and immoveable, excellently corresponding to the variable and moveable Structure of Heat ; as an Anvil to the Hammer : for if both Principles were variable, and changeable, they wou'd have produced temporary or momentary Bodies. So again, the immense Regions of Heat, which he places in the Heavens, are somewhat balanced by the compact Nature of the terrestrial Globe, and the Bodies about it ; as the Thing to be consider'd is not Space ; but the quantity of Matter contain'd in Space. Add to this that the Nature, the *Efficacy*, and the degrees of Cold cannot be largely treated of, for want of Opportunities of making Experiments therewith, in order to arrive at certainty. For the coldness of the Earth has no substitute, within the Power of Man, to make Experiments with, corresponding to that of culinary Fire, which is a kind of substitute for the Sun, and manifests the Nature of Heat. As to the cold Exhalations which arise in the Winter from the Surface of the Earth, in the coldest Regions, and diffuse themselves in the Air ; they are but a kind of warm Baths, in Comparison of the *primum Frigidum* hid in the Bowels of the Earth ; whence the utmost Cold that falls under the Senses, and within the Power of Mankind, may be esteem'd no greater in degree, than that of the Sun in the hottest Countries, compared with the Blast-heat of a Furnace, &c. And in this manner might his other Positions be improved.

6. But

^c See the *Sapientia Veterum*. Fab. 1. Vol. I. p. 550.

6. But the great Fault, both in *Teleſius* and others, who conſtitute *Principles*, is that they derive them from Things which have no Exiſtence; ſo that it were greatly to be wiſh'd Men wou'd once, by a common Conſent, agree to leave off this trifling; and not feign Beings, where no Beings are; or place *Principles* where they find none; and thus avoid embracing a manifeſt Contradiſtion. For *abſtract Principles*, and *perishable Principles*, are no *Principles* at all; whiſt there is an unavoidable neceſſity for Men, if they will talk intelligibly, to have recourſe to *Atoms*; which are real, material, figurate, meſurable Things, capable of Situation, Reſiſtance, Appetite, Motion, Action and Efficacy; remaining for ever unimpair'd and undimi-niſh'd, the ſame thro' all the Deſtructions and Changes of natural Bodies. For as there are ſuch varieties of Corruptions in the larger Bodies, there muſt neceſſarily be ſome *central part*, as it were, that remains unchangeable; and this *central part* muſt either be ſomewhat potential, or extremely ſmall. But it can be nothing potential; for the primitive potential Eſſence cannot be like other Things that are potential; which diſfer in Act from what they are in Power; but it muſt neceſſarily be ſomething abſtracted, as being incapable of all Action, and yet retaining all Power: whence it muſt conſequently be ſome immutable and extremely ſmall Thing; unleſs any one will maintain that there are no *Principles* at all; but that one Thing is a Principle to another; and that the Law and order of Change is conſtant and eternal; and the Eſſence of Things vague, and mutable. And it wou'd be better, expreſſly to aſſert ſomething of this kind, than thro' a deſire of maintaining an eternal Principle, run into a greater Inconvenience, and make that *Principle* phantaſtical. For in the former Caſe there ſeems to be ſome Iſſue; as Things wou'd then change from one to another in a Circle: but on the footing of phantaſtical *Principles*, there is no End; whiſt notional Things, and the Helps of the Mind are held as material Beings.

7. It comes ſtill cloſer to the Point, that there are four *Demonſtrations*, which ſingly confute the Philoſophy of *Teleſius*, as to Principles; and much more when they are united. The *fiſt* is, that there are found ſome very powerful and extenſive Actions and Effects in Things, that can in no wiſe be attributed to Heat and Cold. The *ſecond* is, that there are ſome Natures, of which Cold and Heat are the Effects, and Conſequences, not by the excitation of a Heat inherent in them, or the application of an adventitious Heat; but wherein Heat and Cold are lodged and generated from their fiſt Exiſtence: whence they fail, on both ſides, of being Principles; as there is ſomething that does not proceed from them; and as they themſelves proceed from ſomething elſe. *Thirdly*, that thoſe Things which have their Origin from Heat and Cold, do yet proceed from them, not as from a proper and intimate Cauſe; but only as from an Effect and Inſtrument. *Fourthly* and Laſtly, That his Conjunction of his four connatural Things, is perfectly diſorderly and confuſed. And to each of theſe we propoſe to ſpeak, in particular.

8. It may doubtleſs appear to ſome not worth the while to be ſo ſtrenuous in ſubverting the Philoſophy of *Teleſius*, which itſelf is neither ſa-
The particular
Confutation of the
Teleſius, why
mious undertaken

*The general
Error in eſta-
bliſhing Prin-
ciples.*

*Four Confuta-
tions of the
Principles of
Teleſius.*

mous nor received. We answer, that we are not above considering the more ordinary Matters ; but for *Telefius* himself, we have a good Opinion of him, as of a lover of Truth ; a Man useful in promoting the Sciences ; and one whom we acknowledge a principal modern Improver of certain Doctrines. We are not however here concern'd with him as *Telefius*, but only as he is a Restorer of the Philosophy of *Parmenides* ; to which great Reverence is due. But the chief Reason of our prosecuting this Subject at large, is to lay, upon the first occasion, such a Foundation as may commodiously be transferr'd to the Confutation of the other Sects, which we hereafter propose to consider : so as to avoid the Necessity of repeating the same Things, again and again. For as the Roots and Fibres of different Errors are strangely interwoven and entangled among one another, they may frequently be confuted with one and the same Argument ; as different as Weeds are cut down with the same Scythe ^d.

^d When the Author had enter'd a little into this particular Confutation of the Principles of *Telefius*, the Discourse breaks off abruptly ; so that it seems more agreeable to end it here. It shou'd seem as if the present Piece, had it been finished, was intended to make a Part of the *Tables*, for exhibiting the *ancient and modern Philosophies*, as mention'd Vol. II. pag. 57, 58.

PHYSICAL ESSAYS:

Upon different SUBJECTS,

With Regard to the Improvement of

Natural Philosophy.

I.

Of the CORPUSCULAR PHILOSOPHY.

1. **T**HE Doctrine of *Democritus*, concerning *Atoms*, is either true or useful in Demonstration: for it is not easy to conceive in Thought, or to express in Words, the real subtilty of Nature, such as we find it in Things, without the Supposition of Atoms. *The Notion of Atoms either true or useful.*

2. This Word has two Significations, not greatly differing from each other: being either taken for the ultimate Division, and the *smallest Portion of Matter*; or else for a *solid Particle*, without Vacuity. *The meaning of the Term, double.*

3. As to the first, these two Positions may be safely laid down; *Atoms invisible.*
 (1.) That *there is a much more subtle Division, and Commixture found in Things, than what falls under the Sight*; and (2.) That this *Division cannot be endless or continued, in infinitum*. For a diligent Observer will find much more subtle and fine Parts in continued Bodies, than in such as are separated, and discontinued. Thus a little Saffron will tinge a whole Hoghead of Water; so as to render it distinguishable even by the Sight from pure Water: and this Diffusion of the Saffron thro' the Water, doubtless exceeds the subtilty and fineness of the most exquisite Powder; as may manifestly appear from mixing, in another Hoghead of Water, a like quantity of the Powder of *Brazz* Wood, Balauftines, or any other tinging Body, provided

provided it has not the like tenacity or clamminess with Saffron; which disposes it to spread, open and incorporate with Liquors. It were therefore ridiculous to take *Atoms* for those Corpuscles, that appear in the Rays of the Sun: such Corpuscles being but like fine Dust: whereas, *Democritus* himself declares that for *Atoms*, no Man ever saw, or can see them^c.

The Subtlety of
odorous Bo-
dies.

4. This subtle Division of Things appears much more surprizing in the Case of *Odours*: for as a little Saffron may tinge a whole Hoghead of Water; so a very little *Civet* will impregnate the Air of a very large Room, with its Odour, or even two or three Rooms successively. And let no Man here imagine that Odours diffuse themselves like Light, Heat, or Cold, without any Communication of Substance; since it is observable that Odours will, for a considerable time, adhere to Wood, Metal^f, and other solid Bodies; and may thence be dislodged and cleansed away, by washing and rubbing. But in these and the like Instances, no one of a sound Judgment will pretend that the Process^g is infinite; since such a kind of Division or Diffusion is restrained to certain Spaces, and certain Limits, or Quantities, of Matter; as evidently appears in the preceding Examples^h.

Hero's No-
tion of Atom
and Vacuity
explain'd.

5. As to the *second* Sense of the word *Atoms*, which supposes a *Vacuum*, and defines an Atom from the want of Vacuity; *Hero* has bestow'd laudable Pains about it: denying a *collective* and asserting an *interspersed Vacuity*. For when he saw the constant Connexion of Bodies; and that no Space cou'd be assign'd absolutely empty of Matter; and, what makes more to the purpose; observing that heavy and ponderous Bodies wou'd be carried upwards; or even in a manner, deposite and violate their Natures, rather than suffer an absolute divulsion from the Bodies contiguous to them; he laid it down as certain, that Nature abhorred any great or collective *Vacuum*. On the other hand, when he found that the same Matter of a Body wou'd contract, or condense itself; and again open or dilate; so as sometimes to possess and fill a larger, and sometimes a smaller space; he cou'd not conceive how this Ingress and Egress of Bodies in their places happens, without an *interspersed Vacuity*; that should be less when the Body is compress'd, and greater when it is relaxed. For this Contraction must, of Necessity, arise, (1.) either because Vacuity is excluded (after the manner just now mention'd) in proportion to the Condensation; or, (2.) because some other lighter body, intermixed with the Body condensed, is squeezed out; or, (3.) because there is some certain natural Condensation and Rarification of Bodiesⁱ.

6. As to the *second* Case, that of squeezing out a more rarified Body; it seems inconclusive: for altho Sponges and the like porous Bodies do contract when the Air is squeezed out of them; yet it is manifest by numerous Experi-

^c Perhaps Microscopes cannot be so far improved as to render the original component Parts of Matter visible. Tho this ought to be farther attempted.

^f As we see in perfumed Sword-Blades, &c.

^g Viz. Of Tinging or Impregnating.

^h Viz. Of Saffron and Civet.

ⁱ See the Author's History of Condensation and Rarification, *passim*.

Experiments, that the Air itself is capable of great Contraction. Shall we suppose then that the more subtile part of the Air is squeezed out ; and afterwards another Portion of this part ; and so on for ever ? But it strongly opposes this Opinion, that the more rarified any Body is, the greater Contraction it will sustain ; whereas the contrary shou'd be true, if Contraction happen'd by the Expression of a more rarified part. (2.) As to the *third* way ; that the same Bodies, no otherwise changed, shou'd yet have a greater or less degree of Rarity or Density ; it seems to be a dogmatical Position, depending upon an absurd unexplain'd Supposition, as *Aristotle's* Positions generally do. (3.) The *first* way, therefore, which supposes a *Vacuum*, remains as the justest.

7. If any one shall here object, that it seems strange, and almost incredible that there shou'd be an interspersed Vacuity ; whereas Matter is every where at hand : let him attentively consider the *Instances* above produced, of Water tinged with Saffron, and Air impregnated with Odours ; and he will easily perceive there can be no part of the Water assign'd, where there is not Saffron ; and yet it is plain, by comparing the Saffron, and the Water together, before they are mix'd, that the Body of the Water is immensely greater, than the Body of the Saffron ; and so of the Air and the Odour. And if this be the Case between different Bodies, much rather may it be allow'd between Body and Vacuity.

8. But the Speculation of *Hero*, who was only a mechanical Man, yields to the Speculation of the famous Philosopher *Democritus*, in this, that *Hero* not finding a collective *Vacuum* in the lower Globe of the Earth ; thence directly denied its Existence : for this is no Reason why there shou'd not be a collective *Vacuum* in the Regions of the *Æther*, where, without doubt, there are great Expansions and Rarefactions ^k.

9. Men shou'd here be admonish'd, not to confound their Imaginations, and give themselves up to incertainties, in these and the like Enquiries, by reason of the subtilty of Nature : but to conceive that Generals may as well be submitted to Examination and Calculation as Particulars. Thus it is as easy to mention, or think of a thousand Years, as a thousand Moments : because those Years consist but of Moments. Nor again, let any one imagine, that such Enquiries as these are rather matters of Speculation, than of real Use, and conducive to Works : for we find that all the Philosophers and others, who were vers'd in Experience and Particulars, and have given any true Dissection of Nature, have always fallen upon these Enquiries ; tho indeed with no great Success. Nor is there any juster or stronger Reason, why the present Philosophy remains barren of Works, than this, that it catches at the *Subtilties of Words*, and vulgar Notions ; without pursuing, or determining to enquire into the Subtilty of Nature ^l.

^k See Sir Isaac Newton's *Principia*, passim.

^l For more upon this whole Subject, consult the History of *Condensation and Rarefaction*; and the *Sylva Sylvarum*, passim. See also Mr. Boyle's several Pieces relating to it.

II.

Of the Similarity and Dissimilarity of ATOMS.

*The Numbers
of Pythagoras
explained.*

I. **T**HE Doctrines and Discoveries of *Pythagoras* were generally such as seem better fitted for founding a religious Order, than for opening a School in Philosophy : and the Event confirmed it ; for his Discipline has prevail'd and flourish'd more in the Heresy of the *Manichees*, and the Superstition of *Mabomet*, than among Philosophers. His Opinion, however, that the World consists of *Numbers*, may be taken in such a Sense, as to enter the Principles of Nature : for there are, and may be, two Opinions concerning Atoms, or the Seeds of Things ; the one that of *Democritus* which attributes Dissimilarity, and by Figure, Situation, to *Atoms* : the other, perhaps, that of *Pythagoras*, which wou'd have them all to be perfectly equal and similar. For he who ascribes Similarity to *Atoms*, necessarily places all Things in *Numbers* ; but he who allows of other Properties, employs the primitive Natures of separate Atoms, besides the Numbers or Ways of their coming together.

*The Changes
of Bodies,
whence.*

2. The practical Question corresponding to this Speculation, and capable of determining the Point, is that which *Democritus* himself proposes ; viz. *Whether every Thing may be made out of all Things ?* Which he believing impossible, asserted a diversity of Atoms. But the Question to us seems not well put ; nor so as to press and determine the Point in the preceding Speculation ; if it be understood of the immediate Transmutation of Bodies : but the proper Question is this ; *Do not all Things pass in a due Course of Circulations and intermediate Changes ?* For no doubt but the Seeds of Things, tho similar, after having thrown themselves into certain Knots, or Combinations, entirely put on the Nature of dissimilar Bodies ; till those Knots, or Combinations, come to be dissolved again ; insomuch that the Nature and Properties of Compounds may be as great a hindrance to immediate Transmutation, as the Nature and Properties of simple Bodies ¹. But *Democritus*, tho acute in discovering the *Principles of Bodies*, is dissimilar to himself, and unskilful, in examining the *Principles of Motions* ; which indeed was the common Defect of all the ancient Philosophers. And yet, possibly, this Enquiry concerning the Primitive State of the Seeds or Atoms of Things, may be of the greatest Utility ; afford the supreme Rule of *Action* and *Power* ; and justly direct and govern both Hopes and Works ^m.

*The Action of
Separation to
be effected.*

3. And from hence arises another Enquiry, which tho not so extensively useful as the former ; yet comes closer to Things and Works. This Enquiry regards the Business of *Separation* and *Alteration* ; so as to discover what

¹ This requires to be well consider'd, and, if possible, to be determined ; in order to the working of Changes in Bodies ; and producing physical Effects.

^m For if we cou'd discover the original or primary component Particles of Matter, so as clearly to discern their Arrangements and Compositions, whereon the *Form* or Properties of different Bodies depend ; we might be enabled to separate and combine these Atoms so, as, under due Limitations and Restrictions, to produce all the possible Changes in Matter.

what is effected by Separation; and what by other means. For 'tis an Error familiar to the Mind, and has been spread, and confirmed by the Philosophy of the Chemists, to attribute those Things to Separation, which are the Effect of something else. Thus, for Example, when Water flies off in Vapour, it is easy to imagine, that the more subtle Part of the Water is here discharged, whilst the grosser remains behind; as in green Wood, where one part goes off in Flame and Smoke, and another remains behind in Ashes. And something of this kind might be suspected of Water, in a less manifest degree: for tho the whole Body of the Water may seem to evaporate and be consumed; yet some grosser Parts, like Ashes, may remain adhering to the Vessel. But here the Imagination is liable to be deceived: for it is certain, that the whole Body of the Water may fly off into the Air^a; or if any thing should stick to the Vessel, this may not proceed from a Separation of the grosser Parts; but, perhaps, is the same Substance as that which evaporates; only condensed by coming in Contact with the Sides of the Vessel. So we see that Quicksilver becomes totally volatile with Heat; and is recoverable again without loss. So again, in the Oil of Lamps, and the Tallow of Candles, the whole Quantity of the fat Body becomes volatile; without leaving any Ashes: for Soot is generated after the Flame, not before it; and therefore appears to be the Skeleton or Carcass of the Flame; and not the Dregs of the Oil or Tallow.

4. And this may serve as an Introduction in Nature, to a Confutation of the Notion of *Democritus*, as to a diversity of Atoms: but for the Introduction in Opinion, this is much easier, and almost spontaneous; because the common Philosophy makes its fictitious Matter indifferent, and susceptible of all Forms.

An Entrance to the Confutation of Democritus's Atoms.

III.

Of the vulgar Division of MOTION.

1. **T**HE Division of Motion at present received in Philosophy, seems but popular, and groundless; as distinguishing the Thing only by its Effects, without regarding the Discovery of Causes. For Generation, Corruption, Augmentation, Diminution, Alteration, and local Motion, are no more than the Works and Effects of Motions; which arriving at any manifest change of Things, subject to vulgar notice, they are then very unscientifically called by those Names. For doubtless, the meaning is this; that when a Body, by any kind of Motion has acquired a new Form, or laid aside an old one, so as to complete its Period, or run its course; Men agree to call it a Motion of Generation or Corruption: but if the Form

The vulgar Divisions of Motion superficial.

H h h h 2

still

^a Supposing the Water perfectly pure, or free from all terrestrial Matter; tho there is an Experiment produced to shew that *Water*, by repeated Distillations, is convertible into *Earth*. See Mr. Boyle upon the Subject, and Boerhaave's Chemistry under the Chapter of *Water*.

still remains, and the Body only acquires a new Quality or Dimension; this is called *Motion of Increase or Diminution*. So again, when the Bulk remains the same, whilst the Quality, Actions, and Passions are changed; this they call a *Motion of Alteration*: but if the Form, the Bulk, and Quantity, remain the same, and nothing is altered but the Place, this they term *local Motion*.

Are but the Measures of Motion.

2. Whoever considers these Motions with accuracy and diligence, will find them no other than the Measures of Motions; or only Periods, certain Stages, and as it were Tasks of Motions; and not real Differences: as expressing indeed the Fact, or what is done; but scarce intimating at all how it was brought about. These Expressions, therefore, are necessary in Teaching; and accommodated to the Methods of Logic; but are extremely empty in respect of natural Knowledge. For all these Motions will appear compounded, recomposed, and variously combined, if we would skilfully enter the more simple Operations of Nature. For the Principles, the Fountains, the Causes, and the Forms of Motions, that is, the Appetites and Passions of all kinds of Matter, are required in Philosophy. So likewise are the Impressions or Impulses of Motions, their Checks and Reluctances, their Courses and Obstacles, their Alterations and Mixtures, their Revolutions and Concatenations, and in short, the universal Process of Motions. Warm Disputes, probable Reasonings, vague Contemplations, and plausible Opinions, are here of little service: but the Business is by proper Means, and a suitable Helping of Nature, to excite, restrain, increase, remit, multiply, check, and stop any Motion, in a Body susceptible thereof; and hence either preserve, change or transform Bodies, at pleasure.

Admonition for prosecuting the Enquiry after simple Motions.

3. And here such Motions should principally be enquired after, as are simple, original, and fundamental; of which the rest consist: for it is certain, that as the more simple Motions are discovered, the human Power will be the more enlarged, or the less confined to the use of determinate Expedients; and the greater Command it will have in producing new Works. And doubtless, as that immense Variety of Words in all Languages is composed of a few simple Letters; so all the Actions and Powers of Things consist in a few different kinds of original and simple Motions^o. It would therefore be unworthy of Mankind, to have so accurately sifted and discovered the minute Differences of their own Voice, and yet remain illiterate in the Voice of Nature; and like the first Ages, before the Invention of Letters, understand none but compound Sounds and Words; without distinguishing the simple Elements of Speech, or the Letters of the *Alphabet*^p.

IV. Of

^o See the *Novum Organum*, Part II. Sect. II. Aph. 48.

^p The Author intended, upon this Footing, to have drawn up an *Alphabet of Nature*, containing all the simple Motions, abstract Natures, the cardinal Powers, summary Motions, measures of Motions, &c. but there is only a very imperfect fragment of it, published by Dr. Tenison.

IV.

Of MOTION, and the moving Principles of Things.

1. **T**HE operative Philosopher must lay the stress of his Enquiry upon the Consideration and Examination of Motion ; but the Lovers of Controversy and Dispute, may consider the unactive Principles of Things. We call those *unactive Principles*, which shew, whereof things may be made and consist ; but not the Means and the Ways whereby they may come together and unite. For 'tis not sufficient, or of any great significance to Action, and the enlargement of the human Power, to know whereof Things are compos'd ; without understanding the Ways and Means of producing Changes and Transformations. Thus, does it follow, that he who knows all the simple Ingredients of Mithridate, can certainly make that Compound ? Or must he who has exact Descriptions of the Materials and Utensils employ'd in the making of Glass, Sugar, Cloth, &c. of necessity have the Art of preparing and producing these Commodities ? And yet the Speculations of Men are principally employ'd in discovering and examining these dead Principles of Things : just as if any one should propose and determine to look into the Anatomy of the dead Carcass of Nature ; without enquiring into her Faculties and Powers, when alive and active.

The dead Principles of Motions chiefly enquired into.

2. But all the Enquiry made into the *moving Principles of Things* is little more than transient : and indeed it is astonishing to see how loosely, and with what Negligence, the greatest and most useful Thing in all Nature has been treated and examined. Thus, if we look a little into the Philosophy on foot, we shall find it turning upon such Questions as these : Can Matter be excited by Privation ? Is Matter formed according to Ideas ? Do similar Particles come into Aggregates ? Are Atoms fortuitously tumbled about *in Vacuo* ? Is there any Amity and Enmity in Matter ? Do the Heavens and the Earth make mutual Impressions upon each other ? Do the Heavens hold correspondence by symbolizing Qualities ? Have the celestial Bodies any Influence ? Are there any Sympathies and Antipathies in Things ? Are there any occult specific Virtues and Properties ? Is there any such Thing as Fate or Necessity ? &c. But can all these kinds of Generals, which are nothing but Phantoms that play about the Surfaces of Things, be serviceable to Mankind ; or enlarge our Stock of Knowledge and Power ? They may indeed distend, and swell the Imagination ; but can no way contribute to the Production of Works, the changing of Bodies, or the governing of Motions.

And the moving ones neglected.

3. So likewise to argue, subtilize, and distinguish betwixt natural and violent Motion, Self-motion, and Motion from without ; the Terms and Appellations of Motions, and the like ; is not to grapple with Nature ; but catching at Shadows. All Matters of this kind, therefore, being dropt, or delivered over to vulgar and ordinary Discourse, those Appetites and Inclinations of Things should be discovered, from whence proceeds all that great Variety of Effects and Changes in the Works of Nature and Art : whilst Men thus

The Method of improving effective Philosophy.

endea-

endeavour to bring Nature, like *Proteus*, under Constraint. And certainly, the kinds of Motion, rightly discovered and distinguished, are the true Shackles of *Proteus*: for just as *Motions*, that is, *Incentives* and *Restraints*, are checked and eased, so is Matter converted and transformed.

V.

Of Violent and Projectile Motion.

Aristotle's
Distinction
of violent
from natural
Motion.

1. **V**iolent Motion, as it is called, or the Motion of Projectiles, is one of the most common of all Motions; and yet there has been a strange and supine Negligence, in not attending to and enquiring about it. This Neglect has proved highly detrimental: for the Motion itself is a Thing of infinite Utility; particularly in the Business of Engines and Machines, Gunnery, and all Mechanicks; whereof it is, in a manner, the Life and Soul. There are many who fancy themselves to have finished this Enquiry, by pronouncing the Motion we speak of, to be *violent*; and distinguishing it from *natural Motion*. It is indeed, the peculiar Manner and Conduct of *Aristotle*, and his School, to provide Answers, and short verbal Determinations; but not to adjust and settle Things: they shew how a Man may disentangle himself in Dispute, either by affirming or denying; but not what Judgment he ought to form in his own Mind.

A second Opin-
ion of violent
Motion.

2. Others, with more Attention, laying hold of this Position, that two Bodies cannot be in the same Place at once; will have it, that the more forcible one impels, and the weaker gives way; and that this yielding, if the Force applied be small, continues no longer than the first Impulse, in the way of Protrusion: but if greater, that it continues for some time after the other Body is removed, till it remits by degrees; as in Throwing. And these again, according to another inveterate Custom of the same School, catch at the first Appearances of Things, without troubling themselves much with the Process, or Issue; as if all Beginnings drew every thing else after them: whence they break off their Enquiries with a hasty and untimely Impatience. For to say that Bodies give way upon the first Stroke, is something; but to the Point, how, after the impelling Body is removed, the Motion should continue, they are silent; and have no clear Conception.

A Third.

3. Others again, with greater Diligence and Perseverance, observing that the Force of the Air, as in Winds, &c. sometimes blows down Trees and Buildings; conceive, that the Force attending and carrying Projectiles after the first Impulse, is owing to the Air collected, and rushing in behind the moving Body; so as to impel it forwards, as a Current drives a Ship. And these indeed go thro' with the Matter, and bring the Consideration to a Conclusion; tho' not with the requisite Truth and Justness.

The true Notion
of the Thing.

4. The Fact seems to be this. The principal Motion resides in the Parts of the Projectile; but this Motion, by reason of its Subtlety, being imperceptible to the Sight, Men have carelessly overlook'd it. But whoever considers

siders the Thing attentively will find, that all hard Bodies are extremely impatient of Pressure, and have, as it were, a very acute Sense thereof; inso-much, that if ever so little driven from their natural Figure, they with great Velocity, endeavour to free themselves; and recover their former State. And in order to this, all the Parts, beginning with the first that is struck, thus protrude and thrust one another, as if by an external Force; whence there ensues a continued and intense, tho' invisible Trepidation, Vibration, and Commotion of all the Parts^a. Thus we see Glass, Sugar, and the like brittle Things, break not always in the Part struck upon; but in others remote from that where the Blow was given: which evidently demonstrates this Communication of the Motion of Pressure to the remoter Parts; which Motion extending every way, and exerting its Force all around, causes a Separation in that Part where, from the precedent Disposition of the Body, the Union was least firm. Nor yet does this Motion, tho' it runs thro' and disturbs every part of Body, appear to the Sight, but by the Effect of breaking, or separating the Continuity.

*Exemplified in
the harder
Solids.*

5. So again we see, if a piece of Iron Wire, a Quill, or the like flexible and elastic Body, be bent between the Fingers, and let go again; the Ends presently start back to their former Situation: the Cause of which Motion is, manifestly, not in the Parts of the Body so bent; but in the Middle, that sustained the Force from which this Motion relieves the Body. And in this Example it plainly appears, that the Cause of Motion, above derived from the Impulse of the Air, is plainly excluded; there being here no Percussion to protrude the Air. This is also farther manifest, from that obvious and common Practice of squeezing a Plumb-Stone, whilst fresh and slippery; and thus shooting it from between the Fingers: for here also Compression performs the office of Percussion. But the most evident Effect of this Motion is perceived in the perpetual Rotations or Revolutions of Projectiles, flying in the Air: for tho' they move continually forwards; yet they do it in Spirals, or by rolling round, and moving forwards at the same time. And indeed this spiral Motion being so rapid, and yet so obvious, or as it were familiar to Things, makes us doubt a little, whether it may not depend upon a higher Principle; tho', perhaps, there is no other Cause of the Effect than that now offered: for the pressure of a Body excites a powerful Motion in its smallest Parts, sufficient to make it endeavour to release and free itself every way; whence a Projectile does not only fly strait forward, but every other way tries to free itself; and therefore revolves: for by both these means it does something towards its own Relaxation or Release^r.

6. And

^a If this were the Case, would not the projected Body conceive some small degree of Heat in the Air? Yet it has not, perhaps, been satisfactorily shewn, that a Bullet grows at all hot by being discharged from a Cannon. But in the Instance below, § 5. Iron Wire grows hot by bending. See the *Novum Organum*, Part II. Aph. 11, &c.

^r Let this physical Consideration about the Cause of the rotatory or progressive Motion of Projectiles be compared with Sir Isaac Newton's *Three Laws of Motion*, &c.

*In the softer
Solids.*

6. And tho in Solids this Action may appear somewhat secret and subtle ; yet it is very evident and palpable in softer Bodies : for as Wax, Lead, &c. when struck with the Hammer give way, not only forwards but side ways, and all round ; in the same manner, hard resisting Bodies fly forwards, both in a direct Line, and circularly : for there is a correspondence between the Substance of a yielding soft Body, and the local yielding in a hard one. And the Passion of a hard Body, when it flies and gets away, is clearly understood from the change of Figure produced upon a soft one.

*May be influ-
enced by the
Air.*

7. We do not, however, deny but the Air may have some considerable Share in assisting, hindering, directing, and governing the principal Motion thus excited. And this Explanation of *violent or mechanical Motion*, which has hitherto lain concealed, is a kind of Fountain to mechanical Works and Practice.

VI.

Of the Correspondence between Sensible and Insensible BODIES.

THERE is a great Agreement betwixt the Passions of sensible and insensible Bodies ; excepting only that the sensible Bodies have a Spirit. Thus the *Pupilla* of the Eye is compared to a Looking-glass, or to Water ; as it receives and reflects the Images of Light, and visible Objects, in the same manner therewith. So the Organ of Hearing has a Conformity with the Figure of a Cave ; which excellently reflects Sound and the Voice. Again, the Sympathies or Attractions of Things inanimate, with their peculiar Dreads and Flights, or Avoidances, correspond to grateful and disagreeable Odours in Animals. And for the Business of Taste and Touch, it, on the one hand, expresses, like an Interpreter, all the Violences ; and on the other, all the grateful and friendly Insinuations, and all the Representations of the Passions which can happen in Bodies inanimate. For Compressions, Extensions, Corrosions, Separations, and the like, lie concealed in the Process of lifeless Bodies ; and are not perceived till after the Effect is manifest : but in Animals they are all performed with a Sensation of Pain, according to the different Kinds or Characteristicks of the Violence ; the Spirit here suffering along with them all. And from this *Principle* we may know whether any Animal has another Sensation, besides those observed ; as also how many, and what kind of Sensations there may be in all the Species of Animals. For from the Passions of Matter justly distinguished, will follow the number of Sensations ; provided there be suitable Organs, accompanied with a Spirit, to observe them^f.

VII. *Of*

^f This is a Speculation of Consequence, and may perhaps require a little Illustration. The Bodies of Animals suffer in all respects like insensible Bodies ; that is, with respect to their Matter and external Appearance. Thus Plants are wounded and wither, rot and putrefy, like

IX.

Of apparent REST, CONSISTENCY, and FLUIDITY.

1. **T**HAT certain Bodies should be at rest, or motionless, seems reasonable; if understood of their Wholes; but if of their Parts, it may mislead the Judgment: for there is no such Thing as simple and absolute Rest, both in the Parts and the Wholes of Bodies: but that which is thought to be Rest, proceeds either from some Impediment, Restraint, or equipollency of Motions. Thus, for example, in the Gardener's Watering-pot, which is struck full of Holes at the Bottom; if the Orifice of the Pot be closed, the Water will not run out at the bottom Holes. And this apparently proceeds from a retractive Motion, and not from a quiescent Nature; for the Water still tends as much downwards, as if it were in actual Motion: but as there is no other Body to succeed at the Top of the Vessel, the Water at the Bottom is drawn back by the Water at the Top, and thus forcibly withheld. For if a stronger Man should hold down a weaker, so that with his utmost Strength the weaker should not be able to stir; yet the Motion of Re-action is not the less, for its not prevailing; or for being bound down by a stronger Motion.

Rest in Bodies, how to be understood.

2. And this Distinction of false Rest is proper to be made on many Occasions; and affords great Light in the Enquiry about the Nature of Solidity and Fluidity. For Solids seem to remain quiet, and at rest, in their Position; but Liquids to move about, and be mixed together. Thus a Column or Statue cannot be raised of Water; as it may of Wood or Stone: whence Men are apt to imagine, that the upper parts of the Water endeavour, by a natural Motion to flow downwards; but do not allow the same as to upper parts of Wood or Stone. Yet the upper parts of Wood have the same Tendency downwards, as those of Water; and this Tendency would shew itself, were it not bound down and restrained by another Tendency, that is prevailing; viz. by the Appetite of Continuity, or Avoidance of Separation; which is an Appetite residing both in Water and Wood: only in Wood 'tis stronger, and in Water weaker, than the Motion of Gravity. And that Fluids also have this Motion is manifest: thus we see, in Bubbles of Water, the Fluid throws itself into fine Films, in the form of a Hemisphere, to avoid Separation, or Discontinuance: and so again, in the Droppings of Spouts, the Water, that it may continue one with the other Water,

A false Rest.

Fluids have an Appetite of Continuity.

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stretches

like Animals, living Bodies, &c. But Animals having a Spirit and Perception; or a Sensation of Pain or Pleasure, corresponding to the Action wrought upon them; they know what they feel by a Mark that inanimate Bodies have not: so that the Effects wrought upon inanimate Bodies being known, we may infer that Animals have the same Effects wrought upon them; and a Set of Sensations agreeable thereto; provided they have Organs to perceive and take notice of them. See *Nov. Organ.* Part II. *Aph.* 27.

¹ This Phænomenon is now explained by the Air's Pressure being cut off at the Top; but still continuing at the Bottom, so as to support the Water.

stretches itself out into a fine Thread, as long as any Fluid follows from behind ; but if Water be wanting to supply the Continuation, it then rolls itself up into spherical Drops, the diameter whereof is much larger than that of the former Thread. In like manner we see, that Water difficultly suffers a subtile Division of its Parts ; for it will not by its own natural weight, without Concussion, run out at very fine Holes or Cracks. Whence it is certain, that Fluids have an Appetite of Continuity, tho it be weak.

*But Solids a
stronger.*

3. But in Solids this Appetite is stronger, and over-rules the Motion of Gravity : for if any one imagines that the parts of a Column of Wood, or Stone, have no tendency to fall downwards ; but only to sustain themselves in the same State ; he will easily be undeceived, by observing that such Columns, if their Altitude be not proportioned to the width of their Bases, but run out beyond it, readily over-set, thro' their too great weight a-top. And hence all high Structures must necessarily rise in a pyramidal Form, or grow narrower towards the Top.

*This Appetite
whence.*

4. But what that Nature is which increases and diminishes this Appetite of Continuity, is not easy to discover. It may perhaps be suggested, that the Parts of Solids are more dense and compact ; and those of Liquids more rare and loose ; or that Liquids contain Air, which is a Principle of Fluidity not contained in Solids : but neither of these seems agreeable to the Truth. For it is manifest that Snow and Wax, which may be cut and wrought, and made to receive Impressions, are much rarer than Quicksilver, or melted Lead ; as is evident from the disproportion of their Gravities. But it may be pretended, that perhaps Snow or Wax, tho in their Wholes they are rarer than Quicksilver, yet contain Parts more close and compact ; only, being spongy Bodies they have many Cavities, and contain Air ; whence the total Sum is lighter ; as in the case of a Pumice, which may perhaps be specifically lighter than Wood ; yet if both of them were pulverized, the Powder of the Pumice would be heavier than that of the Powder of the Wood ; because the Pumice now no longer retains its Cavities. We allow this to be well objected : but what shall be said of melted Snow and melted Wax, where the Cavities are filled up ? or, what to gummy Bodies, such as Mastic, and the like, which have not those visible Cavities ; and yet prove lighter than numerous Liquors ?

*Not owing to
Air.*

5. As to the Matter of Air, the Force and Action whereof is suppos'd to cause Fluidity ; this at first sight seems probable, and familiar to Mens common Notions ; but in reality it is erroneous and somewhat hard to conceive ; being not only destitute of a just Reason, but almost opposite to Reason : for this pretended Air really induces Consistence, and not Fluidity, as appears evidently in the Instance of Snow ; which is a Body compounded of Water and Air ; each of them separately fluid ; yet acquire a Consistence by Mixture. If it be here objected that this may happen from a Condensation of the aqueous Part by Cold, and not from an interposition of the Air ; we have an Instance to the contrary in Froth, which is a Body like to Snow, and yet in no respect condensed by Cold. If it be still urged
that

that in Froth the Condensation proceeds not from Cold, but from Agitation and Percussion; we may have recourse to that Experiment of Children, who by blowing gently thro' a Pipe into soapy Water, raise a Tower or a Structure of Bubbles, one upon the top of another.

6. The Case seems to be this; that Bodies resolve and open themselves upon the Contact of others similar or agreeable to them; but contract and shrink into themselves upon Contact with dissimilar Bodies: whence the Apposition of a foreign Body shou'd seem the Cause of Consistence. Thus we see that Oil and Water mix'd together, as in the making of Unguents, put off their Fluidity; and appear in some measure consistent: on the contrary, Paper moisten'd with Water resolves, and deposits its Consistence, which before was strong, on account of the Air intermix'd in its Pores; but does this less when moisten'd with Oil; because Oil has a less agreement with Paper. And the like we find happens in Sugar and Bodies of that kind, which open themselves to receive Water or Wine: and this not only when such Liquors are poured upon them; but they also attract and draw the Liquor up into their Substance, when no more than their lower Part is dipped therein.

X.

Of the Cause of the Motion of EXPLOSION in Guns and Gunpowder.

1. **T**HE Phænomenon of Gunpowder, and the Cause of Explosion, tho so powerful and noble a Motion, have been hitherto very imperfectly explain'd; and that too in the least considerable Part. They pretend that Gunpowder, when converted and rarified into Flame, dilates itself, and possesses a larger Space; from whence follows the Explosion, or bursting of the obstructing Body; lest otherwise two Bodies shou'd be in one place, or a penetration of Dimensions ensue, or the Form of the Element be destroy'd, or the Situation of the Parts of the resisting Body become preternatural. There is something in this; for the Appetite and Passion of Matter here mentioned, have some share in producing the Effect: but the Error lyes in too hastily bringing the whole to a necessity of the Body's dilating; without distinctly considering what precedes it in Nature. For tho it be necessary that the Body of the Powder, after it is converted into Flame, shou'd possess a greater Space; yet it is not of the same Necessity, that the Body of the Powder shou'd take Flame; and that with such Rapidity: but this depends upon the preceding Conflict, and a train of Motions. For doubtless the solid and ponderous Body, or Bullet, discharged, makes a strong Resistance before it yields; and if this Resistance be great,

The Phænomena of Gunpowder why not well explain'd.

* See Mr. Boyle of Fluidity and Firmness.

it must needs prevail; so as that the Flame shall not drive out the Bullet; but the Bullet stifle the Flame. Therefore, if instead of Gunpowder we were to use Sulphur, Camphire or the like Bodies, which also suddenly catch Flame; and because Compactness hinders Inflammability, if these Materials were form'd into Corns of Powder, with a proper Proportion of the most combustible Wood-Coal; yet if Nitre were not employ'd in the Composition, there wou'd follow no such rapid and powerful Motion as in Gunpowder: but the Motion of Inflammation wou'd be check'd, and kept down by the Resistance of the Bullet; and so the Event be frustrated, or no Explosion be made.

A juster Solution.

2. The Case seems to be this. The Motion here enquired after is double and compounded; for besides the Motion of Inflammation, which principally resides in the Sulphur of the Powder; there is another more strong and violent. This chiefly proceeds from the crude and aqueous Spirit of the Nitre; and somewhat again from the Willow-coal. For this Spirit is not only expanded, as Vapours are by Heat; but, what is here the principal Thing, flies away and bursts forth, with the utmost Violence, from the Heat and Inflammation; for which it thus opens and prepares the way. We see some resemblance of this Motion in the crackling of dry Bay or Ivy Leaves, when thrown into the Fire; and still more evidently in Salt, which approaches nearer to the Nature of the Thing under Consideration: we also find somewhat like it when the Tallow of a burning Candle happens to be wet^u; and frequently in the statulent Flames of green Wood. But a Capital Instance of this Motion appears in Quicksilver; which is an extremely crude Body, and like a metallic Water; the Force whereof when close confin'd and excited by the Fire, is little inferior to, or, perhaps, stronger than, that of Gunpowder. From this Example, therefore, Men are to be admonish'd, and entreated not suddenly to seize upon any one Thing, in the Enquiry after Causes; and hastily pronounce from it; but to cast about, and fix their Speculations deep and strong.

XI.

Of the quantity of MATTER in the Universe.

The Total Sum of Matter always the same.

1. **T**IS evident that all Things change; that nothing is truly lost; and that the total Sum of Matter remains perfectly the same. And as it was the Work of Omnipotence to create Something out of Nothing; the same Omnipotence is required to reduce any Thing back to Nothing. Whether this be effected by a suspension of the conserving Power, or by an Act of Dissolution, is not to the Purpose; 'tis sufficient that it requires the Decree of the Creator. But that Men's Thoughts upon this Position may not be abstracted; or any fictitious Matter introduced; we here advertise, that we

^u Or more remarkably when cold Water is thrown into boiling Oil, first set on Fire.

we conceive Matter endowed with such a Nature, that it may truly be said one Body contains more, and another less thereof, in the same Dimensions : for Example, Lead more than Water, and Air much less than Water ; and this not in an uncertain and indefinite, but precise Proportion ; so as to be exactly calculated and adjusted *. And therefore, if any one shall say that Air may be made of Water, and Water of Air ; there is no absurdity in it : but if we shou'd say that a certain Measure of Water may be converted into an equal Measure of Air ; this is absurd ; and the same as to say that Something may be reduced to Nothing. And in like manner, to say that a certain Measure of Air may be converted into the same Measure of Water ; is to say, that something may be made out of nothing. And from these Positions may be derived three *Precepts*, or useful Admonitions, directing Men to a more skillful, and thence to a more useful Correspondence with Nature.

2. The first is this, that Men shou'd frequently call upon Nature, to give in her Account ; that is, when they perceive a Body, which was first manifest to the Senses, to have flown away and disappear, they shou'd not admit or clear her Account, before they are made sensible whither the Body is gone, or what it is received into. This Matter at present seems treated with the utmost Negligence ; and Men's Contemplations about it generally end with Sight ; so that they do not know even where such a common Thing as Flame betakes itself : for to imagine it changed into the Body of the Air is absolutely erroneous †.

*That Nature
be summon'd
to an Account.*

3. The second Precept is, that Men thus considering the unavoidable Necessity there is in the Nature of Matter to support itself, without being dissolved, or falling into nothing ; they shou'd omit no way of torturing, and working upon Matter ; if they desire to discover and bring its ultimate Operations and Resistances to Light. This Direction indeed may seem not very artificial ; but it is still of Use. Thus in particular, we may observe that the greatest Impediment Men meet with either in working or experimenting, is this ; that they find it scarce possible to preserve a certain Mass of Matter, without Addition or Diminution ; whilst they wou'd urge, press, and subdue it ; but it eludes their ultimate Force by Division or Separation. Now the Separation that may happen here is of two kinds : for either part of the Matter may fly off, as in Decoction ; or at least there may be a Separation, as when Cream rises upon Milk. The Design therefore of a deep and intimate Change of Bodies is to vex and torture the Matter of them to the utmost, by the proper means ; so as to prevent, if possible, these two Separations : for 'tis then that Matter will be really bound and manacled, when all ways of Escape are block'd up or cut off ‡.

*Matter to be
tortured.*

4. The third Precept is, that when Men see Alterations may be made in Bodies, without any Increase or Diminution of their Bulk of Matter, they wou'd first purge their Imaginations from this deep-rooted Error, that Alteration

*Alterations
procurable
without Sepa-
ration.*

* See the *History of Condensation and Rarefaction*, pag. 512, &c.

† See the *Sylva Sylvarum*, under the Article *Flame*.

‡ To see the *History of Condensation and Rarefaction*, pag. 542.

Alteration proceeds only from a Separation of Parts ; and ~~secondly~~, with Skill and Diligence, begin to distinguish betwixt Alterations ; and learn when they are owing to a Separation, when only to a disorder or different situation of Parts, without any Separation ; and when to both. Thus for Example, when an austere and unripe Pear is squeezed, bruised, rolled, or strongly wrought with the Hand, and thence acquires a sweetness ; or when Amber or Gums are reduced to fine Powder, and lose their Colour and Beauty ; it is not conceivable that any considerable Portion of their Substance shou'd be wasted ; but only the Parts of the Bodies brought into a new Arrangement or Order.

*That Spirits
and subtle
Bodies may be
confined.*

5. There is also another Error to be extirpated, of such Force, that, if it prevails, some of the Particulars here intimated may be held as desperate : for it is a common Opinion that the Spirits of Things, when rais'd or rarified by Heat to a certain high degree of Tenuity, will escape thro' the small Pores of the most solid Vessel, whether of Silver, Glass, &c. which is not true : for neither Air nor Spirit, tho' rarified by Heat, nor even Flame itself readily becomes so fine, as to pass or make its way thro' such Pores. Nor indeed wou'd Air sustain to be close confined and compressed, if it cou'd any way perspire and get out at the Pores of the containing Vessel. Men, therefore, need not be so apprehensive that the Spirits of Bodies shou'd easily escape them ; especially since the *Spirits* they frequently require, which are those of Odours, Tastes and the like, may certainly be confined.

XII.

Of the Ebbing and Flowing of the SEA.

*First Motions
of the Sea.*

1. **T**HE Causes of the *Ebbing and Flowing of the Sea* were touch'd upon by the Antients ; and afterwards dropt : but have again been renew'd by the Moderns ; tho' with such a variety of Opinions, as seems rather to confound the Imagination, than discuss the Point. *Vulgar Conjecture* attributes this Phænomenon to the Moon ; by reason of some Correspondence between the Tides and the Moon's Motion : but, if we carefully examine the Matter, there will appear some Traces of Truth, capable of leading us to greater Certainty. To prevent Confusion in this Enquiry, the Motions of the Sea shou'd be first distinguish'd ; which, tho' considerably multiplied by some, are in Fact no more than *Five* : one whereof is irregular, and the others constant.

Currents.

2. The *first* Motion is that uncertain and various kind, call'd by the name of *Currents*. The *second* is the great Motion of the Ocean, every six Hours ; by which the Waters come up to the Shoars, and fall back again alternately, twice a Day ; tho' with such a difference as makes a Revolution once in a Month. The *third*, is the menstrual Motion, and no other than a Restoration of the diurnal Motion, just now mention'd, to the same Courses again. The *fourth* is the same menstrual Motion, by which the Tides have

have an increase at new and full Moon, above what they have in the Quarters. The *fifth* is the half-yearly Motion ; by which they rise remarkably higher in the Equinoxes. But the *second*, or great *diurnal Motion of the Ocean* is the principal Subject at present ; and we shall only touch upon the rest in the way, as they may help to explain this capital one.

3. (1.) First, therefore, as to the Motion of the *Currents* ; doubtless in the Production hereof, the Waters are either straiten'd by some narrow Passages or Channels ; run free from some open Places ; or descend down a Declivity ; or ascend some Eminence ; or flow upon an even Bottom ; or meet with Inequalities, Rises and Falls ; or chop in with other Currents, and mix and go along with them ; or else are agitated by the Winds, especially those that are Anniversary, or Stationary, and return at certain Seasons of the Year. And from these or the like Causes, the Waters may vary their Tendency, and their Eddies, as well in the Consecution and Progress of their Motion, as in the Velocity or Measure of their Motion ; and thence constitute *Currents*. 'Tis therefore manifest that in the Sea, the Depth of the Channel, the Intervention of submarine Rocks and Caverns, the Windings of the Shoars, the jutting out of Promontories, the Interposition of Bays, Gulphs, Islands, and many other Things variously situated, may act powerfully, affect the Waters, and direct their Courses, their Windings, and their Eddies, to all the Points of the Compass, according to the particular Configuration and Position of these accidental Things, with regard to one another ; or as such Obstacles, Declivities, or open Passages happen in the way.

Origin of Currents.

4. The Consideration of this particular, and as it were fortuitous Motion of the Waters, must for the present be dropt ; that it may not disturb the Enquiry : for it wou'd be wrong to reject what we shall offer about the natural and general Motion of the Ocean, because this Motion of the *Currents* does not agree, or conspire therewith. For *Currents* are mere Compressions of the Water, or their endeavour to free themselves from Compression ; and are accordingly particular, respective, and conformable to certain Situations of the Sea and Land ; and to the Winds that blow in particular places. And this is the rather to be remembered and observed, because the *general Motion of the Ocean*, now under Enquiry, is so mild and gentle as to be perfectly subdued and made subservient to the force of the Currents ; and be govern'd and directed by their Motion. That this is the Case appears plainly from hence, that the simple Motion of the Flux and Reflux of the Sea is not perceived in the middle of the Ocean ; especially where the Waters have a wide spread ; but only at the Shoars. Whence it is no wonder it shou'd lye conceal'd, and be in a manner destroy'd by the Currents, upon account of its feeble Force ; if where the Currents have the Direction, this Motion did not somewhat add to their Strength ; and check them a little, where it is opposite or unfavourable.

The Motion of the Currents to be excluded.

5. Having thus excluded the *Motion of the Currents*, we proceed to those four constant Motions ; viz. the *Diurnal*, the *Menstrual*, the *Semimenstrual*, and the *Equinoctial* Motions ; the former whereof alone seems to excite the flowing of the Sea ; whilst the menstrual Motion appears only to determine and

The Motion of the Flux and Reflux to be chiefly considered.

and restore that Motion, and the Semi-menstrual and Semi-annual, or Equinoctial, Motions only to swell and increase it: this original Motion causing the Flux and Reflux of the Waters, which to a certain height overspread the Sea-Shoars, and again forsake them, and return at different Hours with a different Force and quantity; whence those three other Motions are made visible. This Motion therefore, of the *Flux and Reflux*, must be treated separately; and in the peculiar manner it requires.

*This Motion
either Undula-
tory or Pro-
gressive.*

6. And first it must absolutely be allow'd that this *Motion* is either a Motion of rising and falling; or a Motion of Progression in the Waters. By a Motion of rising and falling, we understand such an one as appears in boiling Water; whilst it rises up and sinks down again: and by a Motion of Progression, such an one as we find in Water moved in a Basin; whilst forsaking one side, it rises on the other. That this Motion is not of the first kind appears from hence, that the Tides vary in Point of Time, in different Parts of the World; so that whilst they flow in some Places, they ebb in others at the same Hours: whereas if the Waters had no progressive Motion, and moved not from one place to another, but swell'd up from the depth of the Sea; they wou'd rise and sink in all Places at the same time. Thus we see that the Equinoctial and Semi-menstrual Motions have their Effect and Operation, over the whole Globe at once: for the Tide of Flood every where rises higher in the Equinoctial and Spring-Tides; but no where in the Quarters. In these two latter Motions, therefore, the Waters seem perfectly to rise up and sink down again; or like the Planets to have their *Apogee* and *Perigee*. But in the Flux and Reflux of the Sea, we speak of, the Case is quite contrary: which affords a certain Sign of a progressive Motion.

*The Tides may
be owing to
the Attraction
of some celest-
tial Body.*

7. Besides, if this Flux of the Waters should be attributed to a bare Swelling or Rising; let us attentively consider how it must happen: for it must either proceed, (1.) from an increase of Quantity in the Waters; or, (2.) from an Extension, or Rarification thereof, in the same Quantity; or, (3.) from a simple rising in the same Quantity, and the same Bulk or Body. But the *third* Case must absolutely be rejected: for if the Water be raised up as it is, there must of necessity be a *Vacuum* left between the Earth and the bottom of the Water; because there is no Body of equal Density to succeed in its Place. And for the *first* Case, if the Quantity of the Waters is increased, the additional Part must necessarily spring or flow from the Earth. But lastly, if there be an Extension, this may happen either by Rarification, or by an *Appetite of approaching some other Body which attracts the Water, and raises it up*. And certainly this Swelling, Rarification, or Tendency of the Water to some of the celestial Bodies, seems no incredible Thing; if it be only in a moderate Quantity: and a considerable space of Time be allow'd for such a Swelling to collect and rise ². And therefore that Excess of the Waters observable betwixt the ordinary Tides, and the Spring-Tides, or even those that are still larger, the Equinoctial Tides, being not equal to the

² As there is in Sir Isaac Newton's Theory: The Action of the Moon, not having its Effect upon the Water till three hours after she has passed the Meridian.

the difference betwixt the Tide of Flood, and the Tide of Ebb; and there being likewise a large Compass of time allow'd for the making of this gradual Increase; the Thing does not appear contrary to Reason. But that so large a quantity of Water, as the difference between the Tide of Flood, and the Tide of Ebb, shou'd return so quick as every six Hours, (whence *Apollonius* idly fancied the Earth to draw in and discharge the Waters in the way of Respiration) is a Phænomenon extremely difficult to account for.

8. It may be objected, that certain Springs are said to have a Correspondence with the Flux and Reflux of the Sea; whence it might be suspected, that the Waters included in the Caverns of the Earth, rise and fall in the like manner: so that the Tumefaction of the Sea cannot well be attributed to a progressive Motion. But this is a superficial Instance: for it may easily be answered, that the Tide of the Sea coming in, may fill up many open and cavernous places of the Earth; and thus turn the Course of the subterraneous Waters; and also drive back the Air shut up in those Places; so as by a continued Succession to protrude and raise the Waters of these Springs. And hence, this is not the Case in all Springs, and indeed but in few; tho it ought to be general, if the universal Mass of Waters had a Nature and Property of rising and sinking alternately; in Conformity with the Tides of the Sea. But, on the contrary, this Phænomenon is rare, and look'd upon as extraordinary; because such Passages and Communications of Springs with the Sea, are seldom to be found, without some Obstruction or Impediment. And to this purpose it may be proper to observe, that in deep Mines lying near the Sea, the Air is said to be rendered so thick as to endanger Suffocation to the Diggers, at the time of the flowing of the Tide: from whence it might seem manifest, that the Waters do not rise, where none are evidently perceived to do so; but only that the Air is driven back by the Tide coming in.

Objection from the ebbing and flowing of Springs.

9. There is another Instance produced of much greater weight; and highly deserving of an Answer: for it has been carefully observed, that the Sea ebbs and flows upon the Coasts of *Europe* and *Florida* at the same time. But this Objection will be clearly removed, by what we shall soon deliver as to the Course and Progress of the Ocean. The Sum of the Matter amounts to this, that the Waters of the *Indian* Ocean being obstructed and straiten'd by the Shoars of the old World and the New, they are protruded down the *Atlantic*, from South to North: whence it is no wonder they shou'd flow equally on both Shoars; as those Waters do which are driven from the Sea into the Mouths and Channels of Rivers; where it is plain that the Motion of the Sea is progressive to the Rivers; and yet overflows the opposite Shoars, at the same time. But we must here, according to our Custom ingenuously confess, and admonish Mankind to observe

That the Sea ebbs and flows in Florida and Europe at the same time.

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^a Except from the Attraction of the Moon, which in her Course constantly draws the Waters into a spheroidical Figure. See Sir *Isaac Newton's Theory of the Tides*, explain'd by Dr. *Halley*, in the *Philosophical Transactions*, Lowth. Abridgm. Vol. II. p. 285—288.

and remember, that if it shall be found by Experience, that the Tide comes in at the same time upon the Shoars of *Peru* and *Cbina*, as it does on those of *Europe* and *Florida*; the Notion of a progressive Motion in the Flux and Reflux of the Sea must be rejected ^b. For if the Tide rises at the same time upon the opposite Shoars of the *Southern* and *Atlantic Ocean*, there are no other Shoars in the World, where the Reflux corresponds at the same time. But Judgment must be form'd of this from Experience; to which we assign it over: and in the mean time conceive, that were it known how the whole of this Matter stood, over all the Globe, we shou'd find that in some Parts there was such a Flux at a certain Hour, as there is a Reflux in others^c. At present, however, we must suppose for a Progressive Motion, in the *Ebbing and Flowing of the Sea*.

The Cause of
the Effect, in-
quired into.

10. We come next to enquire from what Cause, and from what Correspondence of Things, this Motion of the *Flux and Reflux of the Sea* proceeds. For all the greater Motions, when regular and constant, are not solitary, or single; but have others in the Nature of Things, whereto they correspond. And thus both the Semi-menstrual and the menstrual Motions of the Tides, appear to *coincide with the Motion of the Moon*; and their Equinoctial Motion with the Motion of the Sun: and again the rising and falling of the Waters, resembles the Apogees and Perigees of the Planets. But we desire Men wou'd observe, that it does not presently follow that those Things which correspond in Course and Period of Time, or even in the manner of their Motion, must be by Nature subordinate to, or the Cause of, one another. For we dare not proceed so far as to assert, that the Motions of the Sun, or Moon, are the Causes of the Motions below, which correspond thereto; or that the Sun and Moon have a *Dominion or Influence over these Motions of the Sea*: tho such kind of Thoughts find an easy entrance into the Minds of Men; by reason of the Veneration they pay to the Celestial Bodies. But in the Semi-menstrual Motion, it will, if rightly consider'd, appear a perfectly uncommon and strange kind of Subjection, for the Tides at the New and Full Moon to be the same, when the Moon is different. And many other Arguments might be produced to abolish all fanciful Notions of such over-ruling Powers; and rather lead up to the general Passions and Appetites of Matter; and the primary Structure of Things; from whence these Resemblances proceed: not as if one was govern'd by another; but because they both flow from the same Origins, and concomitant Causes ^d. Tho it is still true

^b See the *Memoirs of the Royal Academy of Sciences at Paris*. An. 1713.

^c A full and adequate *History of the Tides*, over all the Globe, is not, perhaps, hitherto procured; tho some considerable Parts may seem to be executed. See the *Philosophical Transactions*, the *French Memoirs*, *Rohault's Physicks*, *Varenius's Geography*, *Newton's Principia*, and *Morhoff's Polyhistor*; *de Mari ejusque Fluxu & Refluxu*. Tom. II. Part II. p. 362, &c.

^d Hence we shou'd remember, that tho the *Doctrine of Gravity* or the Hypothesis of the Moon's *Attraction*, along with that of the Sun, may fully account for the Phenomena of the Tides; yet there may be a more *General Principle*, which causes this Correspondence. And it seems by no means well consider'd, that exact Solutions of Phenomena are no Proofs that the *real Causes* of the *Effect* are discovered.

true that Nature delights in Correspondences ; so that that there is scarce any thing found single or solitary. Whence we ought to examine with what other Motions this diurnal one of the Tides agrees, or corresponds.

11. We may first enquire how this Motion answers to that of the Moon. *Whether the Tides correspond to the Phenomena of the Moon.* And we do not find that it any way corresponds there to ; except in the menstrual Revolution : for the Motion of the Tides every six Hours, which is the Subject of the present Enquiry, in no respect coincides with the menstrual Course. Nor again, is the Flux of the Sea observed to follow upon any Phasis or Alteration of the Moon. For whether the Moon be in her Increase or Wane ; whether she be above or under the Earth ; whether she be elevated higher or lower, above the Horizon ; whether she be in the Meridian, or elsewhere ; the Flux and Reflux of the Sea has no correspondence with any of these Phænomena*. Therefore rejecting the Correspondences of the Moon, we must search for others.

12. Of all the celestial Motions, the diurnal Motion is the shortest ; as being performed in the space of twenty-four Hours : whence it seems most agreeable to refer the diurnal Motion of the Tides to this ; as approaching the nearest : tho there is still a difference between them, of three Parts in four. But this does not press the Matter. What has much more Weight with us is, that this Motion is so divided, as to answer the Divisions of the diurnal Motion of the Heavens ; so that tho the Motion of the Waters is immensely slower than the diurnal Motion of the Heavens ; 'tis yet commensurable with it : for six Hours is a quarter of twenty-four, or a quarter of the Measure of the diurnal Motion ; and this Space is observed in the Motion of the Sea, with a Difference coinciding with the Measure of the Moon's Motion. And therefore we take it almost for certain, that the six Hours Motion of the Tides, is of the same kind with the apparent diurnal Motion of the Heavens. *Have an Affinity with the diurnal Motion.*

13. Laying this down, therefore, as a Foundation, we proceed with our Enquiry ; and conceive that the Whole may be brought to an Issue by prosecuting those three several Questions ; viz. First, *Is the diurnal Motion restrained to the Confines of the Heavens ; or does it extend to the terrestrial Bodies ?* Secondly, *Does the Ocean regularly move from East to West, as the Heavens apparently do ?* And thirdly, *Whence, and in what manner, proceeds the Reciprocation of the Tides, every six Hours ; corresponding to a quarter of the diurnal Motion of the Heavens ; but with a Difference coinciding with the Moon's Motion ?* *Three Particulars comprising the Enquiry.*

14. (1.) As to the first Question ; it should seem, that the revolving Motion from East to West, is not a proper celestial, but a perfectly cosmical Motion : and a primary one in the larger Masses of Fluids ; possessing all the Space from the highest Heavens, to the lowest Waters ; but proceeding with very different degrees of Velocity ; tho in the same Direction : the Velocity however diminishing, in a regular manner, the nearer the Bodies approach to the Globe of the Earth. *The diurnal Motion cosmical.*

K k k k 2

15. And

* This is understood of *visible Correspondence* ; for otherwise, the Author allows that the Tides may be caused by the Attraction of the celestial Bodies. See above, § 7. and 10.

That the celestial Motion is continued to the Earth, argued from the Motion of the fixed Stars and Planets.

15. And first, it seems a probable Argument, that this Motion does not terminate with the Heavens, because it remains in force thro' all the immense Space which lies betwixt the fix'd Stars, and the Moon; a Space infinitely larger than that betwixt the Moon and the Earth; tho this Motion decreases gradually all the way: whence it seems improbable, that Nature should of a sudden, drop such a Consent as had been continued and gradually remitted thro' such an immense Tract. And that the case is thus in the celestial Regions, may be argued from two Inconveniences which would otherwise follow. For as 'tis manifest to the Sense, that the Planets have a diurnal Motion; unless this Motion be allowed natural, and proper, in all the Planets, we must necessarily have recourse to the rapid Revolution of the *Primum Mobile*; which seems entirely contrary to Nature: or else to the Rotation of the Earth; which likewise is licentiously imagined, upon mathematical, and not upon physical Reasons. Whence, probably, the case in the Heavens should be as we have put it.

From the Comets.

16. To leave the higher Heavens; we have an evident Instance of this Motion in the lower Comets, which descend below the Moon, and yet revolve from East to West. For tho they have their own particular and irregular Motions, they still participate of the Motion of the *Æther*, in performing of those Motions; and are carried in the same Direction; tho they are seldom confined within the Zodiac; nor move in regular Spirals, or in a Figure compound of a strait Line; and a Circle; but sometimes run out towards the Poles: yet these retain this rotatory Motion from East to West; tho greatly diminished by a nearer approach to the Earth, and there revolving in lesser Circles. This Motion is, however, strong enough to carry them a very great distance in a short time: for these Comets move round the whole Circumference of at least the Earth and Atmosphere, in the space of twenty four Hours; with the anticipation of an Hour or two.

The constant Wind betwixt the Tropicks.

17. But when, by a continued descent, this Motion comes into those Regions where the Earth acts not only by a Communication of its Nature and Virtue, which checks and deadens the circular Motion; but also by the material Emission of its own Substance, in the form of gross Vapours and Exhalations; this Motion is rendered prodigiously languid, and in a manner latent; tho it be not totally destroyed. For in sailing between the Tropicks, where the Sea is open, and the Motion of the Air is best perceived, and where the Air itself revolves in larger Circles, and consequently swifter; a constant Breeze is found to blow from East to West: so that they who want a West-Wind, are frequently obliged to procure it without the Tropicks. Hence it appears, that this rotatory Motion is not lost, even in the lower Air; only becomes sluggish and languid; so as scarce to be perceived out of the Tropicks. And yet even there too, in *Europe*, where the Sea is calm, and the Sky serene, Sailors observe a certain Breeze of the same kind, following the Sun. And we have some Reason to suspect, that what is observed in *Europe*, where the East Wind is sharp and drying,

drying, and the West Wind more general and moist, does not wholly depend upon this, that the former with us blows from the Continent, and the latter from the Ocean; but also because, as the East-Wind blows in the same Direction with the proper Motion of the Air, it accelerates and quickens that Motion; and therefore dissipates and rarifies the Air: whereas the West-Wind blowing in a Direction contrary to that of the Air's Motion, drives the Air back upon itself; and condenses it. Here also we might mention the common Observation, that the high Clouds generally move from East to West; whilst the Winds near the Earth blow in a contrary Direction. And if this be not always the case, the reason may be, that there are sometimes contrary Winds blowing, some above and others below; whilst the higher, if opposite, disturb the proper Motion of the Air. And thus much may serve to shew that the diurnal Motion is not restrained to the Confines of the Heavens^f.

18. (2.) The second Question is, *Whether the Waters regularly and naturally move from East to West?* By Waters we here understand the collective Mass of that Fluid which makes such a large Portion of Nature, as to have a consent with the Fabrick and Structure of the Universe. And we judge that this Mass of Waters has the same kind of Motion with the Air, tho' in a less degree, and by reason of the grossness of the Body not so manifest and apparent. We shall therefore, for the present, content ourselves with producing three eminent or *prerogative Instances*^g in Confirmation of the Fact. The First is, that there appears a manifest Motion and Flux of the Waters from the *Indian Sea* down to the *Atlantic Ocean*; and this in a stronger and swifter manner towards the *Streights of Magellan*, where there is an opening to the West; and another great one in the opposite Part of the Globe, from the *Scythian* to the *British Sea*. And these Successions of Waters evidently roll from East to West. And here we must particularly observe that in these two Places only, the Seas are open; and have an opportunity of describing an entire Circle; whilst on the contrary, in the middle Tracts of the Globe, they are cut off, and straiten'd by two great Obstacles; the old and the new World; and driven into the two Channels of those Twin Oceans, the *Southern*, and *Atlantic*, as into the Mouths of two Rivers, stretching between the South and the North; which therefore does not affect the Motion of Succession from East to West. So that the true Motion of the Waters may be justly taken from those Extremities of the Globe above-mentioned, where they meet with no Obstacle; but flow natural and unresisted. And this is our first Prerogative Instance.

19. Our second Instance is this. Supposing the Sea to flow at a certain Hour in the Mouth of the *Streights of Gibraltar*; it appears that the Tide must come in slower at *Cape St. Vincent* than there; slower at the *Lands-end*, than at *Cape St. Vincent*; slower at *Kings-Island*, than at the *Lands-end*; slower.

That the Waters move from East to West.

Shewn by the Motion from the Indian Ocean to the Atlantic.

The Difference in the Times of the Tides.

^f See the Author's History of Winds *passim*; and the Specimen of animated Astronomy, Vol. II. pag. 15. &c.

^g See the *Novum Organum*, Part II. Sect. II. *passim*.

flower at the Island *Hechas* than at *Kings-Island*^b; flower at the Entrance of the *British* Channel, than at *Hechas*; and flower on the East of *Normandy* than at the Entrance of the Channel. Thus far is regular. But at *Graveling* the Order becomes perfectly inverted; and proceeds with a great Start; the Tide coming in here nearly at the same time that it does at the *Streights Mouth*. And this second Instance we join with the first: for as was just now said, we conceive that in the *Indian* Ocean, and the *Scythian* Sea, the Waters have their natural Course, from East to West, free, open, and uninterrupted; whereas their Course is straiten'd, and render'd transverse in the Channels of the *Atlantic*, and *Southern* Oceans; and also beat back by the Shores which, on both sides, stretch along from North to South, and allow no free passage to the Waters; except towards the Extremities. But the Protrusion of the Waters caus'd by the *Indian* Ocean to the North, and that on the opposite side, caus'd by the *Scythian* Sea to the South, differ immensely in extent; by reason of the different Force and Quantity of the Waters. The whole *Atlantic*, therefore, down to the *British* Channel, obeys the impulse of the *Indian* Ocean; whilst only the upper part of the *Atlantic*, which stretches towards *Denmark* and *Norway*, yields to the Impulse of the *Scythian* Sea. And this must necessarily be the Case; because the great Islands of the old and new World, have such a Figure and Extent, as widens to the North and sharpens to the South; whence, reciprocally, the Seas to the South possess a greater, and those to the North a lesser space. And hence that vast Mass of Waters, which rolls from the *Indian* Sea, and is turned into the *Atlantic* Ocean, becomes able to protrude and drive down a Course of Waters, by a continued Succession to the North, as it were into the *British* Sea. But that much smaller quantity of Water, which comes from the *Scythian* Sea, and has also, in a manner, a free Passage, in its proper Motion, to the West, along the Coast of *America*, cannot turn the Course of the Waters to the South, beyond the Limits we have assigned, or the Chops of the *British* Channel. And in these opposite Motions, there must necessarily be some Limit; where they meet and conflict together; and where they must immediately change the Order of farther Procedure: and this happens about *Graveling*, as was above observed; this being the Limit of the Flux from the *Indian* and *Scythian* Oceans. And that a certain irregularity of the Tides should be found about *Holland* from these contrary Fluxes, appears not only from the inverted Order of the Times of Flood; but also by constant Observation. And if this be the case, it must necessarily happen, that the more the Parts and Shores of the *Atlantic* Ocean stretch to the South, and approach to the *Indian* Ocean, the earlier the Flux will happen in Precedency; as proceeding from the proper Motion of the *Indian* Sea: and the more they extend to the North, up to the common Limit, where they are repelled by the opposite Torrent of the *Scythian* Sea, the later in Consecution. And that this must
be

^b Neither the *Island Hechas*, nor *Kings-Island*, appear in any of the Maps that I have consulted; nor do I know what other Names these Islands go by.

be the case, plainly appears by the Progress from the *Streights* of *Gibraltar* to the *British* Channel. Whence we conceive that the Flux on the Coast of *Africa* precedes, in point of Time, that in the *Streights*; and conversly, that about *Norway* precedes that about *Sweden*: tho we do not know this to be true from any History or Observation¹.

20. Our third Instance is this. If the Seas that are inclosed on one side, which we call Bays, stretch in their Direction from East to West, which is conspiring with the true Motion of the Waters, they have a strong and vigorous Flux; but if they go in the opposite Direction, their Floods are languid and obscure: for the *Red-Sea* has a large Flux; and the *Persian Gulf*, which runs more directly to the West, has a still larger: but the *Mediterranean*, which is the greatest Bay of all, and the Parts of it, the *Euxine* and *Propontis*, as likewise the *Baltic*; all which decline to the East; are almost without the Tide of Flood; or have it only in a feeble manner. But this Difference appears most conspicuous in the Parts of the *Mediterranean*; which so long as they tend to the East, or decline to the North, seem to lie at rest, without much Tide; but after they turn to the West, as in the *Adriatic* Sea, they have then again a remarkable Flood. Add to this, that the small Reflux found in the *Mediterranean* begins from the Ocean; but the Flux from the opposite side: so that the Water rather follows the Course from the East, than the Return of the Ocean. And only these three Instances, we at present employ, with regard to the second Question, or Head of Enquiry.

*The strongest
Tides in Bays,
that run from
East to West.*

21. We might also offer another Proof, agreeable to those already produced, but of an abstruser Nature; and derive an Argument for this Motion of the Waters, from East to West, not only from the Consent of the Heavens (as mentioned before;) where this Motion is in its strength and vigour; but also from the Earth, where it seems perfectly to cease: whence this Motion might appear to be truly *cosmical*, and to affect all Things, from the highest Heavens down to the more internal Parts of the Earth. We mean, that the diurnal Rotation is performed as we find it, from East to West, upon the proper Poles of the North and South. For the diligence of Dr. *Gilbert* has discovered, that all Earth, or what we call the terrestrial Nature, being not a supple or soft, but a rigid, or, as he calls it, a robust Thing; has a latent Direction, or Verticity, which manifests itself by numerous exquisite Experiments, in the Direction of North and South. But we curb and correct this Observation, so as to assert the Fact only of the external Concretions, near the Surface of the Earth; without continuing it down to the central Parts: for, to make the Earth a Magnet, is a Notion formed upon a slender Foundation; it being impossible that the internal Parts of the Earth should be like any Substance commonly seen; because all Things, with us, are penetrated, relaxed, wrought upon, and fashioned by the Sun, and the celestial Bodies; so as in no respect to correspond with Bodies having such a Situation, as that the Force of the Sun

*The diurnal or
cosmical Mo-
tion.*

¹ See *Philosoph. Transact. Abridgm.* Vol. II. pag. 260—236.

Sun and the other celestial Influences and Effects, cannot reach them. But the upper Incrustations, or Concretions, of the Earth, seem to participate of the Revolutions of the Heavens, of the Atmosphere, and of the Waters; as far as consistent and figured Bodies can have an Agreement with such as are fluid and liquid; that is, not so as to revolve upon Poles, but to have a Direction and Tendency towards them. For, as every Globe, that turns upon a certain Axis, without having a central Motion, participates both of a moveable and a fix'd Nature; so, after the revolving Power is checked, by a consistent or self-determining Nature, yet the Power and App. tite of directing itself still remains, becomes augmented and united: insomuch that Direction and Verticity to Poles in solid Bodies, is the same Thing as revolving upon Poles in Fluids.

*The sex-horary
Reciprocation
of the Tides,
whence.*

22. (3.) The third and last Question is this. *Whence, and in what manner proceeds the Reciprocation of the Tides, every six Hours, coinciding with a Quarter of the diurnal Motion, except the Difference abovementioned?* In order to clear up this Point, let us suppose the whole Globe of the Earth covered with Water, as at the general Deluge. In this Case, we conceive that the Water, being now in one entire Ball, and no way disturbed, would continually move forwards from East to West, every Day for some certain Space, tho no great one; by reason of the Remission and Diminution of this Motion, in the Confines of the Earth. Here, by the Supposition, the Earth wou'd no way, by its Interposition, hinder, or restrain, the free Motion of the Waters. Let us suppose again, the Earth to be one single Island, stretched out in length from North to South; which Form and Situation wou'd greatly check and obstruct the Water's Motion, from East to West. In this Case we conceive that the Waters wou'd proceed in their direct and natural Course for a Season; but that at length, being beat back by the Island, they wou'd return at equal Distances, so as on this footing to make only one Flux, and one Reflux of the Sea, in a Day; at about the Distance of twelve Hours between them. Now suppose again, what is matter of Fact, the Earth divided into two Islands, that of the old and that of the new World, (for the Southern Continent will, by Reason of its Situation, here give us no great Disturbance, no more than *Greenland* or *Nova Zembla*) and that these two Islands stretch almost over three Zones of the World; and between which the *Atlantic* and the *Southern* Oceans take their Courses; and that these Oceans are no where open but towards the *Poles*. On this Supposition, we judge it must necessarily follow, that these two Obstacles will introduce and communicate the Nature of a double Reciprocation to the whole Body of the Waters; and thus make the Quarter of the diurnal Motion; whilst the Waters being bridled on both sides, a Flux and Reflux of the Sea will happen twice a Day, at the distance of six Hours; as both the Accession and the Repercussion of the Waters is double.

23. And if these two Islands were like Cylinders, or Pillars, about which the Waters throw'd themselves, in equal Dimensions, and strait Shoars, this Motion wou'd easily demonstrate itself to every one; tho it now seems to

be confounded and obscured, by so great a variety of Position in the Sea and Land.

24. Nor is it difficult to form some Conjecture, as to what degree of Velocity may properly be attributed to this Motion of the Waters; and how far it may reach in a Day. For it, in order to compute this Velocity, we make Choice of some certain Shoars, which are least mountainous or uneven, and are wash'd by a free Ocean; and again, if the Dimension of the dry Land be taken betwixt the high-Water and the low-Water Mark; and this Distance be four times repeated; by Reason of the four Tides in a Day; and the product of this Number be again doubled, on account of the Tides on the opposite Shoars of the same Ocean; and some additional Allowance be made to the Product, for the perpendicular Altitude of the Shoars, which always rise somewhat above the Channel of the Sea; this Calculation will give the Distance that a Globe of Water wou'd move, in a Day; provided it were free from all Obstruction, and continually went forwards in a circular Progression round the Earth. And it is manifestly no great Distance, that it wou'd thus move in a Day.

The Velocity of the Tides Motion.

25. As to the difference which coincides with the Moon's Motion, and completes the menstrual Period; we judge it to proceed from hence, that the Space of six Hours is not the exact Measure of the Reciprocation; as, in the same manner, the diurnal Motion of none of the Planets falls exactly within twenty four Hours; and that of the Moon least of all: whence the Measure of the Flux and Reflux of the Sea is not a quarter of the Motion of the fix'd Stars, which is perform'd exactly in twenty four Hours; but a quarter of the Moon's diurnal Motion †.

The Motion of the Tides corresponds to the Moon's Motion.

Precepts and Admonitions for the better prosecuting of this Enquiry.

26. **B**EFORE this Matter can be fully and demonstratively settled, there are several lesser Enquiries to be made; and in particular we recommend the following to future Diligence.

27. (1.) Enquire whether the Hour of Flood about the Coast of *Afric* precede the Hour of Flood about the Streights of *Gibraltar*; and in like manner whether the Hour of Flood about *Norway*, precede the Hour of Flood about *Sweden*; and whether this precede the Hour of Flood about *Graveling*.

28. (2.) Enquire whether the Hour of Flood about *Brazil*, precede the Hour of Flood on the Coasts of *New Spain*, and *Florida*.

29. (3.) Enquire whether the Hour of Flood on the Coast of *China*, do not nearly coincide with the Hour of Flood on the Coast of *Peru*; and again with the Hour of Ebb on the Coasts of *Africa* and *Florida*.

† See Sir *Isaac Newton's* Theory of the Tides.

30. (4.) Enquire how the Hour of Flood on the Coast of *Peru*, differs from that on the Coast of *New Spain*; and particularly how the Differences of the Hours of Flood stand in both the Shoars of the Isthmuses in *America*; and again how the Hour of Flood on the Coast of *Peru*, corresponds with that on the Coast of *China*.

31. (5.) Enquire into the heights of the Tides, on different Shoars, as well as their Times: For altho high Tides are generally caused by low Shoars; yet they still participate of the true Motion of the Sea; according as that proves favourable or opposite.

32. (6.) Enquire, particularly, into the State of the *Caspian* Sea, which is a large Collection of Waters, excluded from a free Communication with the *Ocean*; to see if it has any Flux or Reflux; and in what manner they happen: for we conjecture that this Sea may have a single, but not a double Tide, in a Day; whilst the Water forsakes the Eastern Shoar, and rises to the Western of that Sea.

53. (7.) Enquire whether the Tides in the New and Full Moon, and in the Equinoxes prove high, and large, in different Parts of the World at once: not understanding by *once*, the same Hour; for the Hours differ according to the Appulse of the Waters to the Shoars; but on the same Day.

34. (8.) For want of fuller Information, this *general Enquiry* of the Ebbing and Flowing of the Sea, cannot be justly continued down to an Explanation of the Consent of the menstrual Motion of the Sea-Tides with the Motion of the Moon; whether *these Motions proceed from a Subordination to the Moon*; or, *whether they both have one and the same Cause*: which shou'd be farther examined.

35. (9.) The present *Enquiry* is connected with that relating to the Earth's diurnal Motion; which shou'd therefore be clear'd up, before any thing is determined upon this *Head*. For if the Tides of the Sea, be, as it were, the last Extremity of the diurnal Motion; it will follow that the Globe of the Earth is fixed; or at least that its Motion is much slower than the Motion of the Waters¹.

¹ This beginning of an Enquiry about the *Cause of the Tides*, is a posthumous Piece, that occurs among the *Scripta* publish'd by *Gruter*; and seems not intended to have come abroad, till, in the Author's usual manner, it had been brought nearer to Perfection. But imperfect as it is, it may deserve the place here assigned it, among other imperfect Pieces, designedly wrote, not in the *inductive* but ordinary Manner. And these few *Essays* are all that we find the Author left fit to enter this fifth Part of his *Instauratio*.

APPENDIX
TO THE
Fifth and Sixth PARTS
OF THE
INSTAURATION.

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APPENDIX

TO THE

Fifth and Sixth PARTS

OF THE

INSTAURATION.

1. **H**AD the fifth Part of the *Instauration* been finished, according to the Author's Design; it would have contained, not only the best Philosophy he was able to lay down, for the Time; but also the Rudiments of a much more perfect one, reserved for the sixth and last Part of his great Undertaking ^m.

The Design of the fifth Part of the Instauration.

2. This double View of the Author may seem to increase the Difficulty of completing a Philosophy, whereof he has left us no more than a few Sketches; without any explicit Directions for conducting and bringing the whole to a Period.

3. It appears, however, that this *First Philosophy* was to be general, and copied after Nature, in her full Extent and Latitude; so as to include the History of the Heavens, of the Earth, and of Man: tho' the whole was intended only as an Essay, or temporary Structure, to be raised by the ordinary Means; without the assistance of the *Art of Induction*: which Art being afterwards employ'd upon it, was to afford fit Matter for the *Second* or *Perfect Philosophy*.

4. And if a tolerable *First Philosophy* might have been wrote a Century ago, when Natural Knowledge had been but little cultivated; doubtless such a Philosophy may be wrote at present, to greater Advantage; on account of the numerous Experiments and Observations that have of late been made in the several Countries of *Europe*, for promoting all the Parts of Natural Knowledge.

May be advantageously executed at present.

5. At least it cannot be unseasonable, for Persons acquainted with the Lord Bacon's Views, to try what may at present be done towards forming a *First Philosophy* from the many Portions of Natural History that have been

^m See Vol. I. p. 15, 510. Vol. II. p. 404, 405. Vol. III. p. 18, 578, 579.

written since his Time ; beginning with those himself has left us, and descending gradually to the Labours of later Writers, and the Works of the several Societies of *Europe*, instituted for the improvement of Knowledge.

Not already
extant.

6. If a Philosophy of this kind be supposed already extant, in the Writings of M. Robault, du Hamel, or other Systematical Authors ; we must remember, what was before intimated, that the *First Philosophy* of the Lord Bacon was to be general, and formed upon the Model of the Universe ; and that it was to afford Matter ready digested and prepared, as much as possibly it could be without the *Art of Induction*, for forming a *Second* or more perfect axiomatical Philosophy. In which Light, the Works of the abovementioned Philosophers, with others of the same kind, may, so far as they are found solid and serviceable, be received into this *First Philosophy* as Parts ; but cannot be allow'd to execute the whole.

How to be
supplied.

7. Perhaps the End might be answered, in some considerable degree, by digesting into a proper order, the pure Philosophical Matters to be found in the Writings of Dr. Hook, Mr. Boyle, Mr. Evelyn, Dr. Becher, M. Paschal, M. Mariotte, Dr. Stahl, and Sir Isaac Newton ; in the *Philosophical Transactions* ; the *French Memoirs*, the *German Ephemerides*, the *Acta Eruditorum*, &c. so as hence to form a kind of general System of Philosophy ; to be amended from time to time, as new Improvements and Discoveries shall be made. And unless something of this kind be done, it shou'd seem that little Advantage can be rationally expected from all the Labour hitherto bestowed in collecting and registering such numbers of Observations and Experiments, as are to be met with in those Writings.

The Advan-
tages of at-
tempting it.

8. An Attempt in this Way might also serve to shew the Sufficiency or Insufficiency, of our present *Natural History* ; what Progress has been made in the Improvement of Knowledge since the Lord Bacon's time ; how far his Directions have been followed ; what is farther wanting towards completing the Design of his grand *Instauration* ; and, in particular, how far we are prepared to enter upon the last Part thereof, the *Philosophia Secunda*.

9. Again, a *First Philosophy* of this kind might have a great tendency to promote the Accomplishment of all the Parts of the *Instauration* ; and, consequently, the Felicity of Mankind ; which is naturally founded in the Perfection of Philosophy. And, certainly, to procure such a First Philosophy, upon this Plan, were no difficult, or tedious Task ; if properly recommended to a competent number of Hands.

The Second
Philosophy
more tedious
and difficult.

10. But to execute the *Second or Axiomatical Philosophy*, is a Work of much greater Labour, and length of Time ; for, to say the Truth, the present State of Knowledge seems by no means ripe enough to afford it, in any tolerable Perfection ; and perhaps some Ages are still required to bring it to Maturity. So that all we can do, at present, is to labour the under Parts of this grand Structure ; and recommend the finishing of it to Posterity.

Yet not to be
despaired of.

11. We may, however, form some tolerable Idea of this future Philosophy ; be convinced that it is within the human Abilities to procure ; and assured, that some considerable Foundation is already laid for it. Thus much cannot well be doubted of by those who understand the Nature and

Use

Use of the Author's *Novum Organum*, and his several Portions of *inductive History*, to be met with in the *Sylva Sylvarum*, *History of Life and Death*, &c.^a

12. Nay, if Men would in earnest bend their Endeavours this way; and were possessed of a just and actuating Notion of the Thing intended; the Work might be greatly shorten'd in point of Time: But to possess Mankind with a just Notion of the Thing, is no small part of the Difficulty; and cannot be removed without some Labour of Thought on their own side. And, indeed, unless the *Novum Organum* be understood, and its force perceived and felt, there are little Hopes of making the generality of Men sensible of their own Philosophical Abilities.

The Time of bringing it to Perfection might be short- en'd.

13. This great Work, therefore, must, of necessity, be conducted by those who understand the way of working with Engines; where the Strength of others may be advantageously employ'd, to an End which the Labourers will not be easily apprized of.

14. The Things wanting to perfect the Design are; (1.) a compleat *Inductive History*; or a full set of Enquiries into Nature, with a direct View to the forming of Philosophy; (2.) The Completion of the Art of Induction, or the Execution of the whole Design of the *Novum Organum*; (3.) The due Application of this Art to the Matter of Inductive History; so as thence to deduce *Axioms* of the highest Order, for Practice, Contemplation, and human Uses; (4.) A Collection of these Axioms ranged in exact Method; so as to form one single Systematical Philosophy, in Conformity with Nature; and exhibit a true Draught, or Copy, of the Universe, with all its Laws; and (5.) a short but full Explanation, annex'd to each Axiom; so as to break it into Parts, and bring it down to particular Cases, both of Theory and Practice.

The Particulars required for prosecuting the Work.

15. A Philosophy procured in this manner is the ultimate End of the *Instauration*; an End worthy of the Author; and fixed with true Judgment, as a desirable, yet possible Pitch of Perfection; to which human Knowledge may arrive, by a right Use and Application of the human Faculties.

The Second Philosophy the End of the Instauration.

16. A little to exemplify and illustrate the Method of raising such a Philosophy; let us suppose, (1.) A particular Inductive History carefully wrote, or a rigorous Enquiry made about the Business of common Fermentation; so as to register all the prerogative Instances, capital Facts and Phænomena, or principal Changes observed in the several Subjects employ'd; as Grapes, Malt, Treacle, Sugar, &c. (2.) That these Instances being carefully ranged or tabled, and thoroughly considered, reduce themselves, by the Method of Rejection, or Art of Induction, to this single *Axiom*; viz. That a *saccharine Matter is the Basis of Wines, Beers, Vinegars, and Brandies*. (3.) This Axiom wou'd then be the Result of the Enquiry; and, like an Algebraical Expression, or general Theorem, contain several Arts wrapped up in few Words. But, (4.) To verify this Axiom, and render it fit to be relied on,

The way of forming it exemplified.

^a See Vol. I. p. 16.

or worthy to enter the *Second Philosophy*; it must be verified by particular Experiments. Thus, if a saccharine Matter be the Basis of Wines, &c. let Art try to obtain a Sugar from all the Substances that afford Wines, &c. And (2.) again, if a saccharine Matter be the Basis of Wines, &c. let Wines, &c. be made from Sugar. The Experiments therefore must be tried; and if Sugar can be procured from all fermentable Substances; if these Substances will not afford Wines, &c. after the Sugar is got out; and if Wines, &c. can be made from Sugar; the *Axiom* may appear duly confirmed; or verified. (5.) To draw out the several Arts abovementioned, and shew how they may all be hence improved or perfected, requires a particular Explanation, under the several Heads of Wines, Beers, Vinegars and Brandies; or the Arts of the Wine-maker, Wine-Cooper, Vintner, Brewer, Vinegar-maker and Distiller; each whereof may be improved, and some of them perfected by this Discovery.

At least a Collection of imperfect Axioms may be deduced from Enquiries.

17. The *Axiom* here set down is purposely made Choice of, because it was the Result of an Enquiry^o, prosecuted with some Diligence; and if the *Axiom* be not absolutely perfect; yet it affords a highly useful physical Canon: by means whereof many considerable Things may be perform'd. And, doubtless, it wou'd prove of great Advantage to have a Collection made of such *Axioms*, which tho not perfectly true, or thorowly verified, shou'd yet hold in most Cases, or rarely fail; and serve as useful Guides tho not infallible. But then such *Axioms* must always be the Result of Enquiries; and be found, not made: otherwise they are of no validity; and can never be trusted.

The Method general.

18. The Example above proposed is taken from Physicks; but the same Method of Investigation is equally fitted for improving all the Parts of Knowledge; so that Civil Policy, Ethicks, Law, Medicine, and the other Branches of Science, may be perfected in the same manner: whence it appears, that the Lord *Bacon* has thus open'd a Way for bringing Philosophy to its highest Perfection; and Mankind to their greatest temporal Happiness.

^o See Vol. III. p. 224.

The End of the THIRD VOLUME.

A General

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